CENTRAL AND SOUTHERN FLORIDA PROJECT
EVERGLADES AGRICULTURAL AREA STORAGE RESERVOIRS

REVISED DRAFT
INTEGRATED PROJECT IMPLEMENTATION REPORT
ENVIRONMENTAL IMPACT STATEMENT

U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT

SOUTH FLORIDA WATER
MANAGEMENT DISTRICT

FEBRUARY 2006

This Report Contains 2 Volumes

You Are Here

Volume 1 – Main Report

- Abstract
- Foreword
- Executive Summary
- Table of Contents
- Section 1 – Introduction
- Section 2 – Existing Conditions / Affected Environment
- Section 3 – Future Without Project Conditions
- Section 4 – Identification of Problems and Opportunities
- Section 5 – Formulation of Alternative Plans
- Section 6 – The Selected Alternative Plan
- Section 7 – Environmental Effects of the Selected Plan
- Section 8 – Plan Implementation
- Section 9 – Summary of Coordination and Environmental Compliance
- Section 10 – Recommendations
- Section 11 – Glossary of Terms and Acronyms
- Section 12 – Preparers of the PIR
- Section 13 – References
- Section 14 – Index

Volume 2 – Annexes and Appendices

- Annex A – U.S. Fish and Wildlife Service Draft Fish and Wildlife Coordination Act Report and U.S. Army Corps of Engineers Responses
- Annex B – Section 404(b)(1) Evaluation
- Annex C – CZMA Consistency Evaluation
- Annex D – Revised Draft Project Operating Manual
- Annex E – RECOVER Reports
- Annex F – Water Quality Monitoring Plan
- Annex G – Legislative and Statutory Requirements
- Annex H – Pertinent Correspondence
- Appendix A – Engineering
- Appendix B – Economic and Social Considerations
- Appendix C – Environmental
- Appendix D – Recreation
- Appendix E – Real Estate
- Appendix F – Draft Water Quality Assessment Report

CENTRAL AND SOUTHERN FLORIDA PROJECT
EVERGLADES AGRICULTURAL AREA STORAGE RESERVOIRS

REVISED DRAFT INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT

U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT

SOUTH FLORIDA WATER
MANAGEMENT DISTRICT

FEBRUARY 2006

This page intentionally left blank

EVERGLADES AGRICULTURAL AREA STORAGE RESERVORS

INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT

Responsible Agencies: The lead agency is the U.S. Army Corps of Engineers, Jacksonville District. The South Florida Water Management District is the non-Federal cost-sharing partner for the study.

Abstract: Current operations of the C&SF Project involve water supply and flood releases to manage water levels in Lake Okeechobee, the Water Conservation Areas, and the East Everglades. Lake management practices have resulted in higher than desirable lake levels associated with periodic large freshwater discharges to both the Caloosahatchee and St. Lucie River Estuaries, which has severely disrupted productivity in the ecological communities in those estuaries. The high lake levels also damage the ecological communities within the lake's littoral zone. System changes have also resulted in water deliveries to the Greater Everglades that include higher peak flows following major rain events, and flow rates that decline more abruptly following the end of the wet season. While lowering lake levels is a recognized need, there is also a need to maintaining existing levels of water supply for agricultural and public purposes. These issues highlight the balance that the CERP, and the EAA Storage Reservoir project as an integral part of the CERP, must achieve to be successful.

This integrated Revised Draft Project Implementation Report (PIR) and Draft Environmental Impact Statement (DEIS) documents the selection of a recommended alternative plan, for restoration of the South Florida ecosystem, located within the Everglades Agricultural Area. The study area included portions of western Palm Beach County. The features of the plan include an above ground reservoir, Stormwater Treatment Area (STA), and improvements to primary and secondary canals. The reservoir covers approximately 31,000 acres, with a storage capacity of 360,000 acre-feet. It is located on lands previously acquired for restoration activities in the Everglades ecosystem by the Department of the Interior and the South Florida Water Management District. It would provide water storage from Lake Okeechobee and the EAA basin via the Miami Canal, North New River Canal, and Bolles and Cross Canals and redistribution of water through improvements to these canals. Embankments enclosing the reservoir are 23 feet high to accommodate extreme rainfall and wind events. Embankments would have a top width of 12 feet, and incorporate underground cutoff walls to provide stability and prevent excessive seepage into adjoining areas. A 1,495 acre STA will provide water quality improvements for waters directed south to meet natural system demands in the Everglades region. Additional features include improvements to existing pump stations G-372 and G-370, construction of two new pump stations, and construction of new borrow/seepage canals. The reservoir and STA would contribute to Everglades restoration by improving the quantity, quality, timing and distribution of water within the greater Everglades. The selected alternative plan will benefit Lake Okeechobee, St. Lucie and Caloosahatchee Estuaries, Water Conservation Areas and Everglades National Park. Additionally, the plan will have localized benefits include wetlands, deep water refugia delivery canals, and terrestrial habitat.

THE OFFICIAL CLOSING DATE FOR THE RECIEPT OF COMMENTS IS 45 DAYS FROM THE DATE ON WHICH THE NOTICE OF AVAILABILITY OF THIS EIS APPEARS IN THE FEDERAL REGISTER.

If you require further information on this document, contact:
Ms. Rebecca Weiss
U.S. Army Corps of Engineers, P.O. Box 4970,
Jacksonville, Florida 32232-0019
Telephone: 904-232-1577
E-mail: Rebecca.J.Weiss@saj02.usace.army.mil

This page intentionally left blank

FOREWORD
A note to the reader of this Revised Draft PIR/SEIS

Prior to completion of this Revised Draft Project Implementation Report (PIR) and Supplemental Environmental Impact Statement (SEIS), the State of Florida determined that it was urgent to accelerate funding, design, and construction of critical restoration projects to capture immediate environmental, social, and economic benefits in the South Florida region. To that end, the State of Florida's "Acceler8" program was established, including the Everglades Agricultural Area Reservoir A-1 project. The South Florida Water Management District (SFWMD) is the state agency responsible for water resources management in South Florida and acts as the non-federal sponsor for federal water resources projects, including the Comprehensive Everglades Restoration Plan (CERP). The SFWMD is also responsible for implementing the Acceler8 program.

Since the SFWMD anticipated that the review of this Draft PIR/SEIS under the CERP Programmatic Regulations, Corps of Engineers policy requirements, and public and agency review requirements of NEPA, followed by subsequent preparation and submittal of a Final PIR/SEIS for eventual Congressional review and authorization were not likely to be completed on the construction schedule originally established by the SFWMD for the Everglades Agricultural Area Reservoir A-1 project, the SFWMD decided to pursue a Corps of Engineers regulatory permit issued under Section 404 of the Federal Clean Water Act (supported by a separate regulatory EIS) for the Acceler8 project so that construction could begin as scheduled in 2006.

The Acceler8 project (Everglades Agricultural Area Reservoir A-1 project) is similar to a component of the NEPA preferred alternative or Tentatively Selected Plan, described in this Revised Draft PIR/SEIS. The SFWMD's proposed Acceler8 project represents approximately one-half the dimensions (e.g., area and storage volume) of the PIR preferred alternative. The purposes of the preferred alternative identified in this Draft PIR and the Acceler8 project are consistent, but the completion of the Regulatory EIS and receipt of associated permits and required land use approvals are expected to occur more quickly than a final agency decision on this PIR/SEIS, thereby enabling the SFWMD to initiate construction in 2006 as scheduled.

The Draft Regulatory EIS is available for public and agency review at the same time as this Revised Draft PIR/SEIS for the proposed Federal project. For details of the Acceler8 project, the reader is referred to the Regulatory EIS. The availability of both documents will be noticed in the Federal Register and the Regulatory SEIS will be posted on the Jacksonville Corps District web site (http://www.saj.usace.army.mil/) and this Revised Draft PIR/SEIS is posted on the CERP website (http://www.evergladesplan.org).

This page intentionally left blank

CENTRAL AND SOUTHERN FLORIDA PROJECT
EVERGLADES AGRICULTURAL AREA STORAGE RESERVOIRS

REVISED DRAFT INTEGRATED
PROJECT IMPLEMENTATION REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE), Jacksonville District in cooperation with its co-sponsor, the South Florida Water Management District (SFWMD), has prepared a Revised Draft Integrated Project Implementation Report (PIR) and Environmental Impact Statement (EIS) for the Everglades Agricultural Area (EAA) Storage Reservoirs project in western Palm Beach County, Florida. This report describes the purpose and need for the project, location, and evaluations conducted which affirmed that an above–ground storage reservoir in the EAA is a cost-effective solution to achieving the benefits of the project and the system-wide benefits for the South Florida ecosystem and the other water-related needs of the region identified in the Central and Southern Florida (C&SF) Project Comprehensive Review Study (Restudy). The selected plan is synonymous with the "Preferred Alternative" or "Preferred Plan" in the National Environmental Policy Act (NEPA) regulations (40 CFR 1500-1508).

The selected plan will provide 360,000 acre-feet of above-ground storage volume, and consists of two cells (Cell 1 and Cell 2, approximately 17,000 and 14,000 acres in size, respectively) each with a 12 foot storage depth. Features of the selected plan include embankments, canals, pump stations, water control structures, and environmentally responsible design features to provide fish and wildlife habitat such as a buffer area, littoral area, and deep-water refugia. The selected plan also includes canal conveyance improvements for the existing Miami, North New River, and the Bolles and Cross Canals of the C&SF Project and a stormwater treatment area (STA).

The purpose of this report is to support a new authorization for the project in accordance with the requirements of Section 601(d) of the Water Resources Development Act of 2000 (WRDA 2000).

PURPOSE AND NEED FOR THE STUDY

Currently, there is not enough storage in the regional water management system in South Florida to prevent harm to natural system areas during wet periods when high water levels in Lake Okeechobee must be lowered to maintain flood control. Conversely, during dry periods, there is not currently enough water available in the regional system to meet competing needs for

environmental, agricultural, municipal, and Tribal water supplies. To address these needs, the purpose of this project is to provide storage for releases from Lake Okeechobee to reduce the harmful effects of flood control releases on the St. Lucie and Caloosahatchee Estuaries, enable more effective management of water levels in Lake Okeechobee to promote recovery of fish and wildlife habitat resources in the lake, provide a source of additional water to improve fish and wildlife habitat in the Everglades, and to provide an alternate source of water for agricultural water supply needs in the EAA. The EAA is located in western Palm Beach County between Lake Okeechobee and the Everglades Protection Area (see Compartment "A", Figure 1).

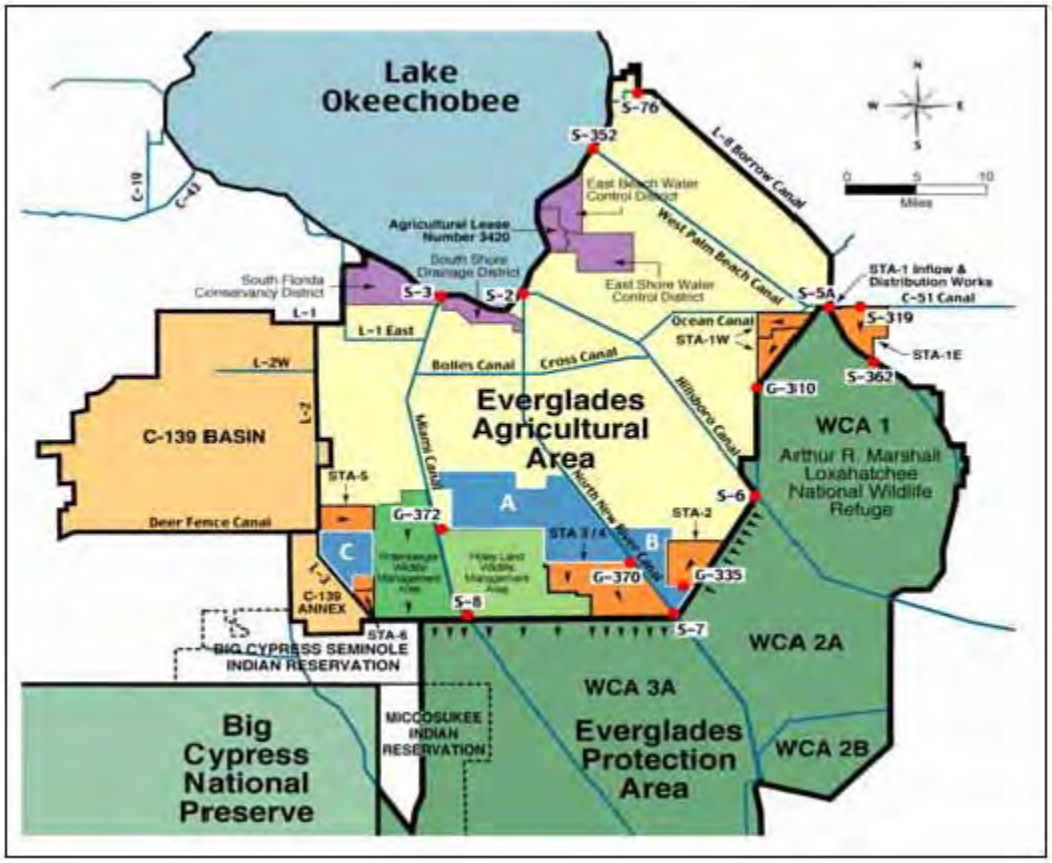

FIGURE 1: PROJECT AREA

WHAT IS EXPECTED TO HAPPEN WITHOUT THE SELECTED PLAN?

Regional adverse ecological conditions in the project area, which would continue without the selected plan, include large swings between unacceptable high and low water levels in Lake Okeechobee. High water levels in Lake Okeechobee frequently result in ecologically damaging flood control releases of fresh water to the Caloosahatchee and St. Lucie Estuaries. These periodic harmful discharges of excess water from Lake Okeechobee down the C-43 (Caloosahatchee) and C-44 (St. Lucie) canal/river systems would continue to severely disrupt the estuarine ecosystems receiving these discharges. These extreme pulses of fresh water will continue to decrease salinity in the estuaries and increase inflows of nutrients and other contaminants into the estuaries, resulting in elevated turbidity levels, algal plankton blooms, loss of normal sea grass cover, and declines in the diversity and abundance of natural populations of invertebrates, fishes, and other estuarine-dependent species. The flushing would also continue to stress the estuarine fish and invertebrates that utilize this habitat as a nursery area. Loss of juvenile fish and shellfish as prey for predatory fish and birds has a cumulative adverse impact through the estuarine and marine food web, including reducing the abundance and viability of commercially and recreationally important fish and shellfish populations. The estuarine and marine resources of the Caloosahatchee and St. Lucie Estuaries that are currently affected by fresh water discharges from Lake Okeechobee cannot recover unless additional storage is added to the regional water management system to enable water management practices that can ameliorate the harmful impact of those fresh water releases. The capability to release excess water in Lake Okeechobee to the south to maintain flood control is also expected to continue to be affected by the timing and conveyance of EAA runoff water to the Everglades Construction Project STAs, potentially resulting in episodic by-pass discharges of untreated water into the Everglades Protection Area.

Holding water levels in Lake Okeechobee higher than would otherwise be preferable would also continue to adversely affect fish and wildlife habitat resources within the lake. Without providing additional regional storage so that lake levels may be more effectively managed, much of the lake's littoral zone would still be under water at the start of the spring rainy season, reducing the extent of this habitat. Since the littoral zone is critical foraging and nesting area for wading birds (including the endangered Everglade snail kite), the reproductive success of those species utilizing the littoral zone habitat is expected to continue to be lower than is acceptable to maintain healthy, viable populations of those species. Additionally, rainy season back-pumping of EAA surface water into the lake to maintain flood control in the EAA will continue to contribute to harmful high water levels in the lake, in addition to increasing nutrient loading and turbidity levels in the lake. Storing nutrient-rich waters in the lake would continue to cause reduced water clarity and periodic algal

blooms, which will continue to adversely affect submerged aquatic vegetation and the habitat, diversity, and abundance of in-lake fish populations. During dry times, withdrawals of Lake Okeechobee water for irrigation and municipal and Tribal water supplies would continue to create harmful low water levels in the lake and reduce the availability of water to maintain optimum flows and levels in the Caloosahatchee and St. Lucie Estuaries.

Since discharging excess water during wet periods to tide is expected to continue without the project, it is also expected that there will be less water available than is necessary to maintain desirable water levels in the Everglades Protection Area (including Everglades National Park) during dry periods.

ALTERNATIVE PLANS CONSIDERED

Initial plan formulation involved consideration of management measures that would increase the capability to manage high water levels in Lake Okeechobee and provide additional storage in the South Florida region. These were screened from further consideration since it was reaffirmed through cost-effectiveness analysis that an above-ground storage reservoir within the EAA is the most cost-effective means of achieving the goals and objectives of the Comprehensive Everglades Restoration Plan (CERP) and the specific benefits of the EAA Storage Reservoirs project. To complete the plan formulation and evaluation, a final array of alternative plans with differing configurations, depths, footprints, and construction techniques were compared to determine the most cost-effective plan.

All of the alternative plans include storing flood control releases from Lake Okeechobee, providing an additional source of water for the Everglades Protection Area, and providing an alternate source of agricultural water supply for the EAA.

In addition to the "No-Action" alternative, five alternative plans that would provide 360,000 acre-feet of storage in the EAA were developed. The alternative plans are:

No- Action (future without project);

An approximately 62,000 acre earthen embankment reservoir with a maximum normal pool storage depth of six-feet;

An approximately 38,000 acre earthen embankment reservoir with a maximum normal pool storage depth of ten-feet;

An approximately 32,000 acre earthen embankment reservoir with a maximum normal pool storage depth of 12-feet;

An approximately 32,000 acre roller compacted concrete embankment reservoir with a maximum normal pool storage depth of 12-feet; and

An approximately 26,500 acre earthen embankment reservoir with a maximum normal pool storage depth of 14-feet.

In addition, conveyance improvements to the following existing canals were included in each of the alternative plans: Miami Canal, North New River Canal, and Bolles and Cross Canals.

The alternative plans were compared using a system formulation and evaluation approach to identify the alternative plan that maximizes net system-wide benefits of the comprehensive plan. This was accomplished by evaluating environmental benefits (habitat units) for the Caloosahatchee and St. Lucie Estuaries, Lake Okeechobee, and the Everglades Protection Area as part of a system formulation and evaluation analysis (i.e., the alternative plan plus all of the other projects in the CERP compared to the future without-project condition). An incremental analysis was also performed as part of the system-wide evaluation. A next-added incremental justification analysis was also performed to determine if the benefits attributable to the selected plan are sufficient to justify its cost as a stand-alone project (if no additional CERP projects are built). The State of Florida's "Everglades Agricultural Area A-1 Project" being implemented through its "Acceler8" program is similar to the Cell 1 component of the selected plan, and was therefore evaluated as an increment of the selected plan during the plan formulation and evaluation conducted for this project.

SELECTED PLAN ELEMENTS

The selected plan, Alternative 4, features an approximately 31,000-acre above-ground reservoir impoundment with earthen embankments and a maximum normal pool storage depth of twelve feet. The reservoir is divided into two cells, Cell 1 and Cell 2, approximately 17,000 and 14,000 acres in size, respectively. Both reservoir cells include individual inflow pump stations, discharge structures, emergency overflow spillways, and seepage control canals with associated structures. Total acreage required for the selected plan is estimated to be 31,640 acres (including the area of the seepage canals to the south and west of the reservoir). A stormwater treatment area comprised of approximately 1,495 acres is proposed east of the Miami Canal and west of the reservoir. The layout of the selected plan is depicted in Figure 2.

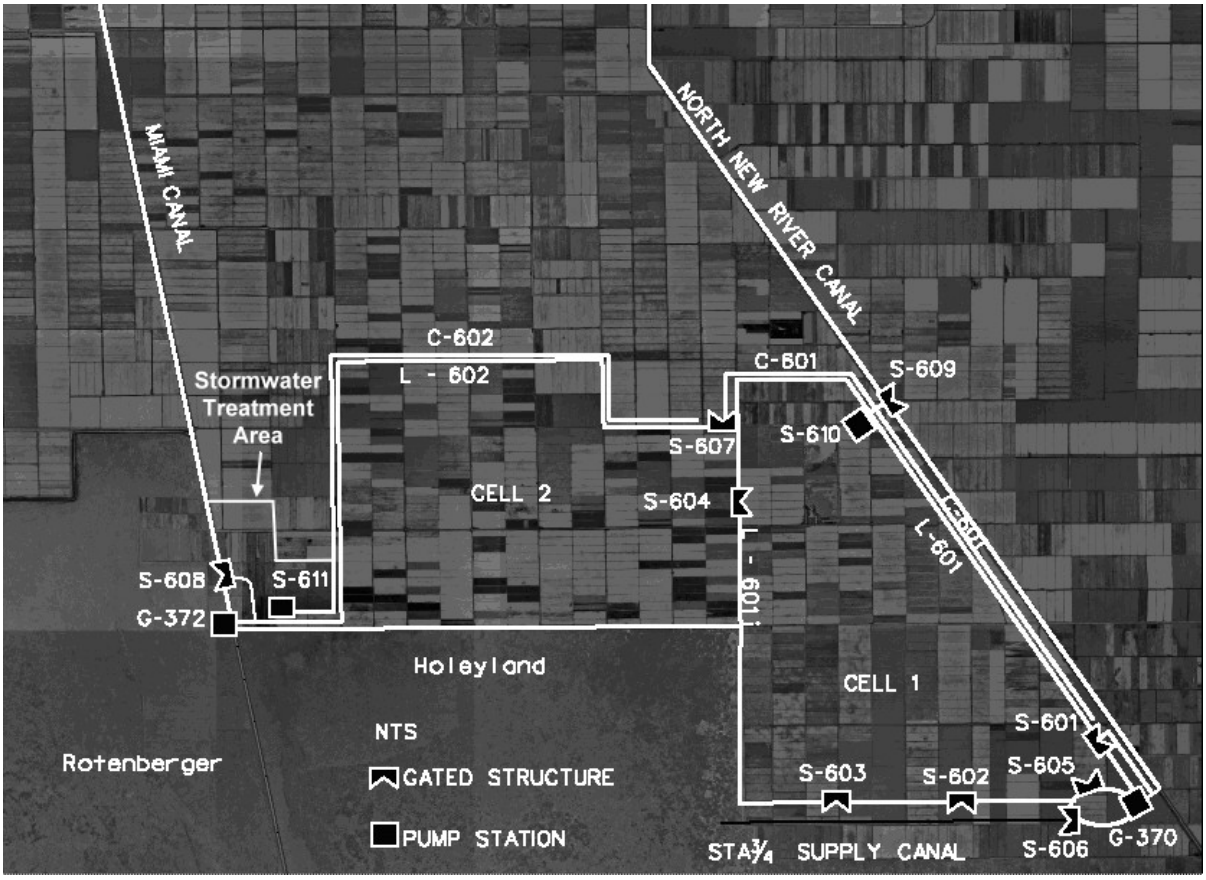

FIGURE 2: EAA RESERVOIR LAYOUT

Reservoir Design

The total storage surface area of the reservoir is approximately 31,000 acres with a maximum normal pool depth of 12 feet deep, and provides 360,000 acre-feet of storage volume. Earthen embankments surrounding the reservoir will have a minimum height of 23 feet above ground. The internal embankment separating the two cells is 21 feet above ground.

Seepage Buffer

The 200 foot wide seepage buffer runs along the east, north, and western boundaries of the reservoir. This seepage buffer will extend 200 feet from the base of the embankment. In addition to providing its intended seepage management function, it will also provide wildlife habitat within the project footprint, encompassing a total of 560 acres. The design of the buffer is to mimic an upland-wetland mosaic and allow for maintenance of the reservoir embankment. The first 50 feet of the buffer from the toe of the embankment will be an upland maintenance corridor. From 50 to 100 feet, the buffer area would be re-graded to pre-construction elevations and allowed to re-vegetate naturally as a wetland. From 100 to 200 feet, the buffer area would contain a deeper (-2

feet elevation from existing) excavated wetland interspersed with tree islands sloped to 4 feet above existing grade. Tree islands will be approximately 50 feet wide, providing approximately 95 acres of tree island habitat. Approximately 278 acres of wetland habitat will be created in the buffer. The elevated tree islands will be planted with appropriate native tree species.

Deep-water Refugia and Littoral Zone

Deep-water fish refugia will be created by the existing agricultural ditches and excavation of borrow pits within the reservoir. The area of the borrow pits is approximately 170 acres. The existing ditches and borrow pits will provide fish refuge during periods when the reservoir pool elevations approaches average ground elevation.

The littoral zone feature will be created by constructing a 30 foot wide "shelf" along the length of the seepage canal for approximately 110,000 feet. The littoral shelf will provide an estimated 76 acres of habitat for fish and wildlife, especially wading birds.

Pump Stations

The selected plan includes modifications to existing pump stations and construction of new inflow and seepage management pump stations. G-370 is an existing pump station that is currently being used as the STA 3/4 inflow. Currently, stormwater runoff and Lake Okeechobee releases in the North New River Canal pass through this pump station and into the STA 3/4 distribution system. This pump will be modified to be used as the reservoir Cell 1 inflow as well as inflow to STA 3/4. This will provide approximately 2,000 cubic feet per second (cfs) of inflow from the North New River to Cell 1.

G-372 is an existing pump station that is currently being used as the STA 3/4 inflow. Stormwater runoff and Lake Okeechobee releases in the Miami Canal pass through this pump station and into the STA 3/4 distribution system. This pump will be modified to be used as the reservoir Cell 2 inflow structure. This will provide approximately 3,000 cfs of inflow from the Miami Canal to Cell 2.

S-610 is the reservoir inflow pump station with a total pumping capacity of 2,505 cfs and is located on the east side of Cell 1 on the North New River Canal. The S-611 is a seepage collection pump station for Cell 2 with a total pumping capacity of 800 cfs.

Gated Culverts

The selected plan includes numerous gated culverts to facilitate the management of water within the reservoir cells and to release water out of the reservoir. S-601 is a 2,000 cfs outlet for Cell 1 into the North New River Canal and is located near the southeastern corner of Cell 1 just north of the G-370 pump station. S-602 and S-603 are 3,000 cfs culvert structures located on the southern Cell 1 levee and discharge into the STA 3/4 supply canal. S-604 is a 2,000 cfs culvert structure located in the internal reservoir levee (L-601i) between Cells 1 and 2. S-604 is a 2,000 cfs culvert to provide flows between Cells 1 and 2. S-605 is a 2,000 cfs inlet structure from North New River Canal, via Pump Station G-370, into Cell 1. S-606 is a 2,000 cfs outlet structure from Cell 1 to the STA 3/4 supply canal. S-607 is a 2,000 cfs outlet from Cell 2 to the North New River Canal, via gated structure S-609. S-608 is a 2,000 cfs outlet from Cell 2 into the Miami Canal. S-609 is a 2,000 cfs outlet from Cell 1 into the North New River Canal.

Canals

The current design conveyance capacity of the Miami Canal of 3,000 cfs will be increased by approximately 50% for an approximately 9 mile section of the canal. The current design conveyance capacity of the North New River Canal of 4,000 cfs will be increased by approximately 150% for approximately 23 miles of the canal between the reservoir and Lake Okeechobee. Improvements to the Bolles and Cross Canals in order to allow water from Lake Okeechobee and the northern portion of the EAA to be more effectively routed to the south require a design capacity of 1,500 cfs. The increase in capacity requirements necessitated an enlargement of the entire reach of the Bolles and Cross Canals totaling approximately 17 miles. All of this canal work will be performed within the existing SFWMD right-of-way

The functions of perimeter canals, C-601 and C-602, are for seepage collection and conveyance of reservoir outlet flows. The seepage canals also serve as a borrow source for construction of embankments. The new perimeter canals will capture seepage at the western, northern, and eastern boundaries of the reservoir. Seepage along the reservoir's southern boundary will be captured by the existing STA 3/4 supply canal.

Embankments

The reservoir has perimeter embankments, L-601 and L-602, with a minimum height of 23 feet above average ground. The height of the internal embankment L-601i is 21 feet above average ground. Cut-off walls will be installed as part of the embankment construction. The estimated depth of the cut-off wall is 35 feet

along the east, north, west, and STA 3/4 sides of the reservoir; a 50-foot deep cut-off wall will be installed along the Holey Land Wildlife Management Area to the south of the reservoir.

Box Culvert and Bridges

The S-609 box culvert structure will be constructed underneath U.S. Highway 27. This structure will serve as a hydraulic connection between the EAA reservoir and the North New River Canal. Bridge relocations will be required due to channel improvements in the Miami, North New River, Bolles and Cross Canals.

Stormwater Treatment Area

Operation of the selected plan involves capturing and storing regulatory releases from Lake Okeechobee and runoff from the EAA and subsequently delivering the stored water for water supply to the EAA and to meet hydrologic targets in the WCAs and ENP. Although the selected plan works in concert with STA 3/4 of the State of Florida's Everglades Construction Project, it is anticipated that the additional hydraulic and phosphorus loading associated with delivering additional water to the WCAs and ENP to meet hydrologic targets will occasionally exceed the treatment capacity of STA 3/4. To ensure that water that is to be delivered to the WCAs and ENP meets water quality requirements, a conceptual stormwater treatment area is included in the EAA Storage Reservoir selected plan.

Approximately 1,495 acres of land already owned by the State of Florida and the SFWMD adjacent to and in the southwest corner of the reservoir have been identified as the likely site for the STA. Additional analysis will be conducted prior to the Final PIR and during the detailed engineering and design phase of the project to refine the design, cost, and operations of this STA. Sizing and optimization of the proposed STA may include converting a portion of Cell 2 to a STA.

Recreation

The planned recreation features will provide biking canoeing, fishing, hiking, horseback riding, hunting, information/interpretive kiosks, motorized boat access, nature study, trail heads with shade shelters, vehicular parking, wildlife viewing, with opportunities attracting users from all around south Florida. The reservoirs are likely to experience high visitation due to its geographic proximity to the Holey Land Wildlife Management Area, STA 5 and STA 6 and due to large public interest in the CERP.

PROJECT COST ESTIMATE

The estimated cost for the EAA Storage Reservoir selected plan is $912,895,089. At this time, the cost estimate does not include any real estate, engineering, design or construction costs for the proposed STA, which will be included as a planning level cost estimate in the Final PIR. Preliminary estimate for the proposed STA include an estimated real estate cost of $8,176,000 for the 1,495 acre site already identified and cost estimates for construction ranging from $57,800,000 to over $150,000,000, based on comparative costs of similar construction. The breakdown of the estimated cost for the EAA Storage Reservoir selected plan is shown in Tables 1 and 2 (2005 price levels).

TABLE 1: SELECTED PLAN TOTAL COSTS

Borrow and Canal	$261,957,593
Levee construction	$191,732,312
Cutoff Wall	$86,086,678
Utility Relocations	$323,857
Bridges	$5,636,497
NNR Canal Improvements	$35,443,519
Miami Canal Improvements	$16,682,354
Bolles & Cross Improvements	$20,745,203
Pump Stations	$122,520,842
Structures	$14,714,934
Manatee Gates	$5,325,000
Recreation	$342,300
Total Construction Cost	$761,511,089
Real Estate	$80,134,000
S&A	$33,750,000
PED	$37,500,000
Total Estimated Cost*	$912,895,089

*Does not include STA costs.

TABLE 2: AVERAGE ANNUAL COSTS

Interest and Amortization	$60,156,678
Operation & Maintenance	$2,413,982
Monitoring	$350,000
Total Annual Cost	$62,920,660

BENEFITS OF THE SELECTED PLAN

Alternative 4, the selected plan (preferred plan for purposes of NEPA), meets all of the project-specific objectives established for the EAA Storage Reservoirs project. The selected plan will improve habitat function and quality and native plant and animal abundance and diversity in the greater Everglades ecosystem.

Based on the system formulation and evaluation, the selected plan is expected to provide an aggregated total of 99,766 average annual habitat units for all habitat types beneficially affected by the project, in comparison to the no-action alternative. Habitat units gained would be in the Lake Okeechobee littoral zone, the St. Lucie and Caloosahatchee Estuaries, and the Everglades Protection Area. The average annual cost per average annual habitat unit is approximately $627, which is well below the national average cost per unit of output for ecosystem restoration projects.

The selected plan will provide additional water for the natural system in WCAs 3A and 3B and ENP which will be reserved or allocated for the natural system by the State of Florida. The selected plan also provides additional water to meet agricultural, municipal, and Tribal water supply needs. The selected plan was also evaluated to determine effects on flood protection. The selected plan is not expected to adversely affect flood protection, and may provide some incidental improvement within the EAA.

Additionally, the selected plan is expected to provide the following local benefits: incidental nutrient removal as a function of water retention and sediment deposition (improving the function of downstream existing STAs); creation of additional shallow seasonal wetlands (wading bird and fish habitat) in the seepage canal littoral zones and seepage buffer areas; and creation of deep water fish refugia in the flooded secondary agricultural canals inside the reservoir.

ADVERSE EFFECTS OF THE SELECTED PLAN

Although implementation of the selected plan may result in temporary or permanent adverse effects, the beneficial effects of the plan significantly offset those adverse impacts. The design of the selected plan also minimizes impacts to cultural resources and fish and wildlife habitat and includes environmentally responsible design features. Therefore, no separable fish and wildlife habitat, cultural resources, or flood damage mitigation is required.

Potential adverse effects of a temporary nature include emission of dust, mobilization of sediments and generation of noise during construction of proposed structures, including excavation, earth moving and embankment and STA construction. USACE construction specifications include appropriate

requirements to maintain noise generation, local water contamination and air emissions within required limits.

Permanent habitat losses due to land conversion to deep water and structures within the footprint would be offset by the gain in habitat quality in Lake Okeechobee, the St. Lucie and Caloosahatchee Estuaries and the Everglades. Permanent adverse effects include: effects on existing habitats, including irreversible commitment and loss of atypical and remnant wetland habitats inside the project footprint; loss of unique farmland and their agricultural productivity; and potential effects on cultural resources, endangered species and visual aesthetic effects. The selected plan would affect three farm parcels covering approximately 32,000 acres and displace a maximum of 20 non-resident owners. It would not impact any known historic or cultural resources. There would be no adverse impacts on minority or disadvantaged populations. Coordination is ongoing to assure that there are no adverse impacts on endangered species. Consultation on the effects of the reservoir to the long-term survival of the Florida panther is also on-going.

The selected plan ranked highest overall among the alternatives evaluated based on the National Ecosystem Restoration (NER), National Economic Development (NED), Environmental Quality (EQ), and Regional Economic Development Effects (RED) accounts. Other considerations, including footprint, construction risk and uncertainty, and public acceptability, were included in plan comparison and selection considerations.

PROJECT JUSTIFICATION

Section 601(f)(2)(A) of WRDA 2000 provides that in carrying out an activity authorized under WRDA 2000, the Secretary of the Army may determine that the activity is justified by the environmental benefits derived by the South Florida ecosystem and that no further economic justification is necessary, provided that it is determined that the activity is cost-effective. This report contains data and evaluations demonstrating that the selected plan is the most cost-effective means of achieving system-wide benefits for the South Florida ecosystem (including other water-related needs of the region) and the benefits of the project. The selected plan is justified through: its incremental contribution toward improving the functions and quality of estuarine habitat in the St. Lucie and Caloosahatchee estuaries consistent with restoration objectives for those estuaries; improving ecosystem function and increasing the spatial extent of viable fish and wildlife in Lake Okeechobee; and improving ecosystem function and increasing the spatial extent of viable fish and wildlife habitat in the Everglades Protection Area, including Everglades National Park. Therefore, no additional economic justification of the selected plan is included in the report.

"ACCELER8"

The State of Florida determined that it was urgent to accelerate funding, design, and construction of critical restoration projects to capture immediate environmental, social, and economic benefits in the South Florida region. To that end, the State of Florida's "Acceler8" program was established, including the Everglades Agricultural Area Reservoir A-1 project. The South Florida Water Management District (SFWMD) is the state agency responsible for water resources management in South Florida and acts as the non-federal sponsor for federal water resources projects, including this project. The SFWMD is also responsible for implementing the "Acceler8" program.

The State of Florida's EAA Reservoir "Acceler8" project (Everglades Agricultural Area Reservoir A-1 project) represents approximately one-half the dimensions (e.g., area and storage volume) of the selected plan. The purposes, initial design, and operational intent of the selected plan and the EAA "Acceler8" project are consistent. SFWMD is currently completing detailed engineering and design work on the EAA "Acceler8" project in order to initiate construction on the "Acceler8" project in 2006 as scheduled.

ENVIRONMENTAL OPERATING PRINCIPLES

The proposed EAA Storage Reservoir is consistent with USACE's seven "Environmental Operating Principles." These principles foster unity of purpose on environmental issues, reflect a new tone and direction for dialogue on environmental matters, and ensure that USACE employees consider conservation, environmental preservation and restoration issues in all Corps activities (http://www.hq.usace.army.mil/cepa/envprinciples.htm). The public was encouraged to participate and provide commentary throughout the compilation of the proposed project document through various letters, documents, and a public forum. The proposed project would help to reverse declining conditions in the Everglades and provide for a return to sustainable, diverse conditions in the natural system. Beneficial effects in the environment were predicted utilizing a peer-reviewed, scientific model for the hydrological network of south Florida. No adverse effects on the human environment were forecast as part of the modeling analysis. The proposed EAA Storage Reservoirs project and PIR/EIS are in compliance with all pertinent laws and is consistent with other restoration activities in south Florida occurring as part of the CERP. In taking a watershed approach, the EAA Storage Reservoirs project would be one of many projects that will beneficially affect the South Florida ecosystem.

COST SHARING AND IMPLEMENTATION SCHEDULE

Responsibilities for implementing the selected plan will be shared by USACE, on behalf of the Federal government, and the non-Federal sponsor, SFWMD. USACE and SFWMD will cost share equally in the design of the projects resulting from this plan. SFWMD has acquired the necessary lands, easements, rights-of-way, relocation, and disposal areas (LERRD) and will operate and maintain the completed project. Construction contracts to build the projects will be managed by either USACE or SFWMD to maintain a 50/50 cost-share. Rules, which determine how project responsibilities are shared, are established in federal law and related implementing policies. Section 601 of WRDA 2000 provides in-kind cost sharing credit to the non-federal sponsor for design, construction, operation, maintenance and for treatment of credit between projects to maintain a 50/50 cost-share. This draft PIR includes recommendations to credit the SFWMD for work completed under the "Acceler8" program in advance of approval and authorization of the federal project. At this time, it is anticipated that the SFWMD's "Acceler8" project for the EAA Storage Reservoir (190,000 acre-feet of storage and auxiliary structures and features) will be included as an increment of Cell 1 of the selected plan.

Detailed design of the "Acceler8" project will be accomplished by SFWMD with coordination and review by USACE. All project features will be designed in accordance with USACE regulations and standards. Construction activities for the "Acceler8" Everglades Agricultural Reservoir A-1 project will be in accordance with the "Acceler8" program established by the State of Florida and will be the responsibility of the SFWMD. Crediting for work performed by SFWMD will be subject to project authorization and adherence to USACE design standards and regulations.

The EAA Storage Reservoirs Final PIR/EIS is currently scheduled to be completed in April 2006. Pending approval, authorization, and appropriation of funds, construction of the Federal project is currently scheduled to be completed in 2010. Detailed design and engineering analysis in support of initiation of construction activities commenced in 2005 under the State of Florida's "Acceler8" program with survey and subsurface geotechnical investigations. Construction is expected to begin on the "Acceler8" project in May 2006. The "Acceler8 project" is expected to be completed in 2009.

The total first cost of the project, including the value of LERRD and pre-construction engineering and design costs will be shared equally between the Federal government and the non-Federal sponsor. The non-Federal sponsor will provide cash or manage a portion of construction as necessary to meet its 50 percent share of the total first cost of the project to be balanced according to Section 601 of WRDA 2000 to maintain a 50/50 cost share as measured

cumulatively for the entire CERP Program. Table 3 shows cost apportionment of the selected plan. The LERRD cost apportionment includes $64,958,000 in credit to the Federal portion of the project. These were federal funds provided by the Department of Interior (DOI) for the purchase of lands in Compartment A of the Talisman Land Exchange pursuant to Section 390, of the Federal Agriculture Improvement and Reform Act of 1996 (Public Law 104-127, 110 Stat. 1022). The $64,958,000 contributed by DOI pursuant to the Farm Bill Section 390 of the Federal Agriculture Improvement and Reform Act of 1996 (Public Law 104-127, 110 Stat. 1022) is to be credited to the Federal share of the project cost pursuant to Section 601 (e)(3) of WRDA 2000.

TABLE 3: COST APPORTIONMENT OF THE SELECTED PLAN

Item	Total	Federal	Non-Federal
Construction (with S&A)	$795,261,089	$372,739,545	$422,521,545
LERRD*	$80,134,000	$64,958,000	$15,176,000
PED	$37,500,000	$18,750,000	$18,750,000
Total**	$912,895,089	$456,447,545	$456,447,545

* LERRD represents Federal Farm Bill funds and State funds expended in 1999 for the lands, required for the 360K 12' plan. LERRD apportionment is currently being coordinated with SFWMD and DOI.
** Does not include STA costs.

UNRESOLVED ISSUES

USACE and the US Fish and Wildlife Service (USFWS) are engaged in formal consultation under the Endangered Species Act to identify and evaluate probable impact to the Florida panther. An initial determination of "may affect, likely to adversely affect" was made for the endangered Florida panther because the recommended reservoir site is in agricultural use and within the habitat expansion area of the panther, requiring evaluation of cumulative impacts to panther habitat, and issuance of a Biological Opinion by the USFWS. Additional concerns about potential impacts to the wood stork and bald eagle are pending based on completion of an evaluation of an ecological risk assessment on the Woerner tract. USACE is working actively with USFWS to resolve the formal consultation and expects timely resolution of these issues.

This page intentionally left blank

TABLE OF CONTENTS

This page intentionally left blank

TABLE OF CONTENTS

SECTION 1

1.0 INTRODUCTION 1-1
1.1 REPORT AUTHORITY 1-1
1.1.1 Project Authorization 1-2
1.2 PURPOSE AND SCOPE 1-6
1.3 PRIOR STUDIES, REPORTS, AND PROJECTS 1-8
1.3.1 Flood Control Act of 1948 1-8
1.3.2 Flood Control Act of 1954 1-9
1.3.3 Flood Control Acts of 1958, 1960, 1962, and 1965 1-9
1.3.4 Flood Control Act of 1968 1-9
1.3.5 Public Law 91-282 1-10
1.3.6 Everglades National Park Protection and Expansion Act of 1989 1-10
1.3.7 Water Resources Development Act of 1992 1-10
1.3.8 Water Resources Development Act of 2000 (WRDA 2000) 1-10
1.3.9 Other Studies, Reports, and Projects 1-10
1.4 PROJECT AREA 1-14
1.4.1 Primary Study Area/Everglades Agricultural Area 1-14
1.4.2 Land Available for Everglades Restoration activities 1-14
1.4.3 Other Areas Affected 1-17
1.5 PROJECT PARTNERS 1-18
1.6 DECISION TO BE MADE 1-19

SECTION 2

2.0 EXISTING CONDITIONS/AFFECTED ENVIRONMENT 2-1
2.1 HISTORY AND PROCESS FOR DETERMINING EXISTING CONDITIONS 2-1
2.2 GENERAL ENVIRONMENT 2-2
2.3 GEOLOGY, TOPOGRAPHY, AND SOILS 2-3
2.3.1 Geology 2-3
2.3.2 Topography 2-3
2.3.3 Soils 2-5
2.3.4 Unique Land Forms 2-6
2.4 HYDROLOGY 2-6
2.4.1 Groundwater 2-6
2.5 FLOOD PROTECTION LEVEL OF SERVICE 2-7
2.6 CLIMATE 2-7
2.6.1 General Climate 2-7
2.6.2 Evapotranspiration 2-8
2.7 AIR QUALITY 2-8
2.8 NOISE 2-8
2.9 VEGETATION AND COVER TYPES 2-8
2.9.1 Lake Okeechobee 2-9
2.9.1.1 Aquatic 2-9

2.9.1.2 Wetlands 2-9
2.9.1.3 Exotic Plants 2-10
2.9.2 Northern Estuaries 2-10
2.9.3 Everglades Agricultural Area 2-11
2.9.3.1 Aquatic 2-11
2.9.3.2 Wetlands 2-13
2.9.3.3 Uplands 2-13
2.9.3.4 Disturbed Communities 2-13
2.9.3.5 Urban and Extractive Communities 2-14
2.9.4 Water Conservation Areas 2 and 3 2-14
2.10 FISH AND WILDLIFE 2-16
2.10.1 Lake Okeechobee 2-16
2.10.2 Northern Estuaries 2-18
2.10.3 Everglades Agricultural Area 2-19
2.10.3.1 Aquatic 2-20
2.10.3.2 Wetlands 2-20
2.10.3.3 Uplands 2-21
2.10.3.4 Disturbed and Urban/Extractive Communities 2-21
2.10.4 Water Conservation Areas 2-21
2.10.5 Canals 2-23
2.11 THREATENED AND ENDANGERED SPECIES 2-23
2.11.1 Lake Okeechobee 2-25
2.11.2 Northern Estuaries 2-25
2.11.3 Everglades Agricultural Area 2-25
2.11.4 Water Conservation Areas 2-26
2.11.5 Species Descriptions 2-26
2.11.5.1 Florida Panther 2-26
2.11.5.2 West Indian Manatee 2-26
2.11.5.3 Wood Stork 2-27
2.11.5.4 Bald Eagle 2-27
2.11.5.5 Audubon's Crested Caracara 2-28
2.11.5.6 Everglade Snail Kite 2-28
2.11.5.7 Eastern Indigo Snake 2-29
2.11.5.8 American Alligator 2-30
2.11.5.9 Sea Turtles 2-30
2.11.5.10 Smalltooth Sawfish 2-31
2.11.5.11 Opossum Pipefish 2-32
2.11.5.12 Okeechobee Gourd 2-33
2.11.5.13 Johnson's Seagrass 2-33
2.11.6 State-Listed Species 2-35
2.12 ESSENTIAL FISH HABITAT 2-35
2.13 WATER MANAGEMENT 2-36
2.14 WATER QUALITY 2-38
2.14.1 Overview 2-38
2.14.2 Monitoring Programs 2-39
2.14.3 Water Quality Parameters of Interest 2-39

2.14.4 Lake Okeechobee and the EAA 2-41
2.14.5 Caloosahatchee River Basin 2-42
2.14.6 St. Lucie River Basin 2-42
2.14.7 Water Conservation Areas 2-42
2.15 SOCIOECONOMICS 2-42
2.15.1 EAA Socioeconomic Characteristics 2-42
2.15.2 Socioeconomic Characteristics of the Reservoir Storage Area 2-45
2.16 LAND USE 2-46
2.16.1 Land Use in the EAA 2-46
2.16.2 Land Use in Compartment A 2-48
2.16.3 Agriculture 2-48
2.17 RECREATIONAL RESOURCES 2-48
2.17.1 Holey Land Wildlife Management Area 2-49
2.17.2 Rotenberger Wildlife Management Area 2-49
2.17.3 Stormwater Treatment Areas 2-50
2.18 AESTHETICS 2-51
2.19 CULTURAL RESOURCES 2-52
2.20 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW) 2-53
2.21 TRANSPORTATION, UTILITIES AND PUBLIC INFRASTRUCTURE 2-55

SECTION 3

3.0 FUTURE WITHOUT PROJECT CONDITIONS 3-1
3.1 FORECAST OF FUTURE CONDITIONS 3-1
3.1.1 Geology, Topography, and Soils 3-2
3.1.2 Flood Protection Level of Service 3-2
3.1.3 Climate 3-3
3.1.4 Air Quality 3-3
3.1.5 Noise 3-3
3.1.6 Vegetation and Cover Types 3-3
3.1.6.1 Lake Okeechobee 3-3
3.1.6.2 Northern Estuaries 3-4
3.1.6.3 Everglades Agricultural Area 3-4
3.1.6.4 Water Conservation Areas 3-6
3.1.7 Fish and Wildlife 3-6
3.1.7.1 Lake Okeechobee 3-6
3.1.7.2 Northern Estuaries 3-6
3.1.7.3 Everglades Agricultural Area 3-6
3.1.7.4 Water Conservation Areas 3-7
3.1.8 Federally-listed Threatened and Endangered Species 3-8
3.1.9 State-listed species 3-9
3.1.10 Water Management 3-9
3.1.11 Water Quality 3-10
3.1.12 Sediment Quality 3-12
3.1.13 Socioeconomics 3-12
3.1.14 Land Use 3-13

3.1.15 Recreational Resources 3-14
3.1.16 Aesthetics 3-14
3.1.17 Cultural Resources 3-14
3.1.18 Hazardous, Toxic, and Radioactive Waste 3-14
3.1.19 Transportation, utilities and public Infrastructure 3-14

SECTION 4

4.0 IDENTIFICATION OF PROBLEMS AND OPPORTUNITIES 4-1
4.1 STATEMENT OF PROBLEMS AND OPPORTUNITIES 4-1
4.1.1 Public Input in Developing Statement of Problems and Opportunities 4-1
4.1.2 Water Quality 4-2
4.1.2.1 Everglades and WCAs 4-2
4.1.2.2 Lake Okeechobee 4-2
4.1.2.3 Northern Estuaries 4-3
4.1.2.4 Opportunities 4-3
4.1.3 Environmental Resources 4-4
4.1.3.1 Everglades and WCAs 4-4
4.1.3.2 Lake Okeechobee 4-5
4.1.3.3 Northern Estuaries 4-5
4.1.3.4 Opportunities 4-5
4.1.4 Fish and Wildlife 4-6
4.1.4.1 Everglades and WCAs 4-6
4.1.4.2 Lake Okeechobee 4-6
4.1.4.3 Northern Estuaries 4-6
4.1.4.4 Opportunities 4-6
4.1.5 Water Supply to Water Conservation Areas 4-7
4.2 PLANNING OBJECTIVES AND CONSTRAINTS 4-7
4.2.1 Project Evaluation Criteria and Evaluation Methods and Models 4-8
4.2.1.1 Evaluation Tools 4-8

SECTION 5

5.0 FORMULATION OF ALTERNATIVE PLANS 5-1
5.1 PRIOR FORMULATION FROM THE COMPREHENSIVE REVIEW STUDY 5-1
5.2 PLAN FORMULATION RATIONALE 5-2
5.2.1 Preliminary Screening 5-2
5.2.1.1 Additional Storage in Lake Okeechobee 5-3
5.2.1.2 Storage North of Lake Okeechobee 5-5
5.2.1.3 Storage East and West of Lake Okeechobee 5-6
5.2.1.4 Aquifer Storage and Recovery Systems (ASR) 5-7
5.2.1.5 Flow-way (broad, shallow marsh areas for free flow of water from Lake Okeechobee to WCAs) 5-9
5.2.1.6 Storage South of Lake Okeechobee in the EAA 5-10
5.2.2 Conclusions 5-11

5.3 ALTERNATIVE PLANS 5-12
5.3.1 Evaluation Tools 5-12
5.3.2 Alternative Plans Descriptions 5-12
5.3.2.1 Reservoir Embankment Construction 5-17
5.3.2.2 Cut-off Wall 5-19
5.3.2.3 Wave Breaking Bench 5-20
5.3.2.4 Riprap Slope Protection 5-20
5.3.3 Pump Station Design 5-20
5.3.4 Culverts 5-20
5.3.5 Ogee Spillways 5-21
5.3.6 Seepage Canals 5-21
5.3.7 Emergency Overflow Spillway 5-22
5.3.8 Conveyance Canals Design 5-22
5.3.9 Flood Damage Reduction 5-22
5.3.10 Land Requirements 5-22
5.3.10.1 Alternative 2 5-22
5.3.10.2 Alternative 3 5-23
5.3.10.3 Alternatives 4, 5, and 6 5-23
5.3.10.4 Acquisition and Construction Assumptions 5-23
5.3.11 Additional On-Site Management Measures 5-24
5.3.11.1 Seepage Management Buffers 5-24
5.3.11.2 Deep Water Refugia 5-25
5.3.11.3 Littoral Shelves 5-26
5.3.11.4 Stormwater Treatment Area (STA) 5-26
5.3.12 Costs of Alternative Plans and Components 5-26
5.3.12.1 Calculation of Average Annual Cost 5-28
5.3.12.2 Earthwork Cost Estimates 5-29
5.3.12.3 Pump Plant Cost Estimates 5-29
5.3.12.4 RCC Cost Estimates 5-30
5.3.12.5 Cut-Off Wall 5-30
5.3.12.6 Other Structures 5-30
5.3.12.7 Planning, Engineering and Design 5-30
5.3.12.8 Construction Management 5-30
5.3.12.9 Contingency 5-30
5.3.12.10 Real Estate Cost Estimates 5-31
5.4 COMPARING ENVIRONMENTAL EFFECTS AND PROJECT COSTS OF ALTERNATIVE PLANS 5-31
5.4.1 Environmental Effects 5-31
5.4.1.1 Fish and Wildlife 5-34
5.4.1.2 Water Quality 5-34
5.4.1.3 Socioeconomics 5-34
5.4.2 Environmental Benefits 5-35
5.4.2.1 Quantification of Ecological Benefits Methodology 5-36
5.4.2.2 Summary of Annualized Benefits 5-42
5.4.2.3 Quantification of System-Wide Benefits 5-47
5.4.3 Ecological Benefit Quantification of Local Environmental Design Features ... 5-47

5.4.4 Risk and Uncertainty 5-49
5.4.4.1 Hydrologic Modeling 5-49
5.4.4.2 Engineering 5-50
5.4.4.3 Evaluation of System-wide Ecological Effects of Hydrologic Performance Measures 5-50
5.4.4.4 Variability of Ecological Response Time 5-51
5.4.4.5 Sequencing and Adaptive Assessment 5-52
5.4.4.6 Construction Cost Estimates 5-52
5.4.4.7 Project Schedule 5-52
5.4.4.8 Land Available and Acquisition Issues 5-52
5.4.5 Evaluation of Alternative Plans 5-53
5.4.5.1 Evaluation Accounts 5-56
5.4.5.2 NED Account 5-56
5.4.5.3 NER Account 5-56
5.4.5.4 EQ Account 5-57
5.4.5.5 Regional Economic Development Account 5-58
5.4.5.6 OSE Account 5-58
5.4.5.7 Real Estate Considerations 5-59
5.4.5.8 Construction Risk & Uncertainty 5-59
5.4.5.9 Other Principals and Guidelines Criteria 5-61
5.4.6 Plan Comparison using Cost-Effectiveness and Incremental Cost Analyses (CE/ICA) 5-62
5.5 IDENTIFICATION OF THE NATIONAL ECOSYSTEM RESTORATION (NER) PLAN 5-66
5.6 PERFORMANCE OF THE NEXT ADDED INCREMENT (NAI) 5-68
5.6.1 Lake Okeechobee NAI Performance 5-68
5.6.2 St. Lucie Estuary NAI Performance 5-69
5.6.3 Caloosahatchee NAI Performance 5-69
5.6.4 Ridge and Slough and Tree Island NAI Performance 5-70
5.7 JUSTIFICATION OF THE TENTATIVELY SELECTED PLAN (TSP) ON A NEXT-ADDED INCREMENT (NAI) BASIS 5-70
5.7.1 Risk and Uncertainty 5-71
5.8 TRADE-OFF ANALYSIS 5-71

SECTION 6

6.0 THE SELECTED ALTERNATIVE PLAN 6-1
6.1 DESCRIPTION OF PLAN COMPONENTS 6-1
6.1.1 Features 6-4
6.1.2 Pump Stations 6-5
6.1.2.1 S-610 Pump Station 6-5
6.1.2.2 S-611 Pump Station 6-5
6.1.3 Gated Culverts 6-6
6.1.3.1 S-601 Gated Culvert Structure 6-6
6.1.3.2 S-602 and S-603 Gated Culvert Structures 6-6
6.1.3.3 S-604 Gated Culvert Structure 6-6

6.1.3.4 S-605 Gated Culvert Structure 6-6
6.1.3.5 S-606 Gated Culvert Structure 6-7
6.1.3.6 S-607 Gated Culvert Structure 6-7
6.1.3.7 S-608 Gated Culvert Structure 6-7
6.1.3.8 S-609 Gated Culvert Structure 6-7
6.1.4 Existing Structures 6-8
6.1.4.1 G-370 Pump Station 6-8
6.1.4.2 G-372 Pump Station 6-8
6.1.4.3 G-374 A-F, G-377 A-E and G-380 A-F Gated Culverts 6-8
6.1.5 Canals 6-9
6.1.5.1 Perimeter Canal 6-9
6.1.5.2 C-601 Canal 6-9
6.1.5.3 C-602 Canal 6-9
6.1.6 Canal Modifications 6-9
6.1.6.1 Miami Canal 6-9
6.1.6.2 North New River Canal 6-9
6.1.6.3 Bolles and Cross Canals 6-10
6.1.7 Levees 6-10
6.1.8 Bridges 6-11
6.1.9 Stormwater Treatment Area 6-11
6.1.10 Other Features 6-12
6.1.10.1 Wetlands Buffer 6-12
6.1.10.2 Deep-water Refugia and Littoral Zone 6-13
6.1.10.3 Recreation 6-13
6.2 COST ESTIMATE 6-15
6.2.1 Initial Costs 6-15
6.2.2 Investment Costs 6-15
6.2.3 Operation, Maintenance, Repair, Replacement, and Rehabilitation Costs 6-16
6.2.4 Annual Costs 6-17
6.3 SELECTED ALTERNATIVE PLAN 6-17
6.4 DESIGN AND CONSTRUCTION CONSIDERATIONS 6-18
6.4.1 Embankments and Canals 6-18
6.4.1.1 Reservoir Embankments 6-18
6.4.1.2 General Construction Considerations 6-19
6.4.1.3 Seepage Canal and Seepage Buffer Area 6-19
6.4.2 Structures/Structural Requirements 6-20
6.4.2.1 Design Criteria 6-20
6.4.2.2 Culverts 6-21
6.4.2.3 Pump Stations 6-21
6.4.2.4 Bridges 6-22
6.4.3 Mechanical and Electrical Requirements 6-22
6.4.3.1 Utility Relocation 6-22
6.4.3.2 Mechanical Design 6-23
6.4.3.3 Electrical Design 6-30
6.5 LERRD CONSIDERATIONS 6-31
6.5.1 Lands and Interests in Lands and Costs 6-31

6.5.1.1 Existing Federal Project 6-31
6.5.1.2 Compartment A 6-31
6.5.1.3 Bolles and Cross Canal Rights of Way 6-32
6.5.1.4 Stormwater Treatment Area and STA 3/4 Supply Canal 6-32
6.5.2 Uniform Relocation Assistance Act, PL 91-646 6-32
6.6 OPERATION AND MAINTENANCE CONSIDERATIONS 6-32
6.6.1 EAA Operations Maintenance Repair Replacement & Rehabilitation (OMRR&R) 6-32
6.7 PLAN ACCOMPLISHMENTS 6-33
6.8 CONTRIBUTION TO ACHIEVEMENT OF INTERIM GOALS AND TARGETS 6-33
6.9 SUMMARY OF ECONOMIC, ENVIRONMENTAL, & OTHER SOCIAL EFFECTS 6-35

SECTION 7

7.0 ENVIRONMENTAL EFFECTS OF THE SELECTED PLAN 7-1
7.1 GEOLOGY, TOPOGRAPHY, AND SOILS 7-1
7.1.1 Geology 7-1
7.1.2 Topography 7-1
7.1.3 Soils 7-1
7.2 HYDROLOGY 7-2
7.3 FLOOD PROTECTION LEVEL OF SERVICE 7-3
7.3.1 Flood Protection Level of Service 7-3
7.4 CLIMATE 7-3
7.5 AIR QUALITY 7-4
7.6 NOISE 7-4
7.7 VEGETATION AND COVER TYPES 7-4
7.8 FISH AND WILDLIFE 7-6
7.8.1 Aquatic Fauna 7-6
7.8.2 Wetland Fauna 7-6
7.8.3 Upland Fauna 7-7
7.8.4 Fauna of Disturbed Areas 7-8
7.9 ENDANGERED, TREATENED, AND STATE LISTED SPECIES 7-8
7.9.1 Florida Panther 7-9
7.9.2 West Indian Manatee 7-9
7.9.3 Wood Stork 7-10
7.9.4 Bald Eagle 7-11
7.9.5 Audubon's Crested Caracara 7-12
7.9.6 Everglade Snail Kite 7-12
7.9.7 Eastern Indigo Snake 7-13
7.9.8 American Alligator 7-13
7.9.9 Sea Turtles 7-13
7.9.10 Smalltooth Sawfish 7-14
7.9.11 Opossum Pipefish 7-14
7.9.12 Okeechobee Gourd 7-14

7.9.13 Johnson's Seagrass 7-14
7.9.14 State-listed Species 7-15
7.10 ESSENTIAL FISH HABITAT 7-15
7.11 WATER MANAGEMENT 7-16
7.12 WATER QUALITY 7-17
7.12.1 Lake Okeechobee 7-17
7.12.2 Caloosahatchee River and Estuary 7-18
7.12.3 St. Lucie River and Southern Indian Lagoon Estuary 7-18
7.12.4 Everglades Protection Area (EPA) 7-18
7.12.5 Canal Modification 7-19
7.13 SOCIOECONOMICS 7-19
7.14 ENVIRONMENTAL JUSTICE 7-21
7.15 LAND USE 7-22
7.16 RECREATIONAL RESOURCES 7-23
7.17 AESTHETICS 7-23
7.18 CULTURAL RESOURCES 7-24
7.19 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE 7-25
7.20 TRANSPORTATION, UTILITITES, AND PUBLIC INFRASTRUCTURE 7-25
7.20.1 Effects to Bridges and Intakes: 7-25
7.20.2 Utility Re-Alignments 7-26
7.20.3 Effects to Roadways: 7-27
7.20.4 Summary of Improvements 7-27
7.21 UNAVOIDABLE ADVERSE IMPACTS 7-29
7.21.1 Soils 7-29
7.21.2 Land Use (Agriculture) 7-30
7.21.3 Wetlands 7-30
7.21.4 Water quality 7-30
7.21.5 Air quality 7-30
7.21.6 Fish and Wildlife Resources 7-30
7.21.7 Threatened and Endangered Species 7-30
7.21.8 Recreation 7-30
7.22 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES 7-30
7.23 CUMULATIVE EFFECTS 7-31

SECTION 8

8.0 PLAN IMPLEMENTATION 8-1
8.1 DIVISION OF IMPLEMENTATION RESPONSIBILITIES 8-1
8.1.1 Project Implementation Schedule 8-2
8.1.2 Pre-Construction Engineering and Design Activities 8-2
8.1.3 Implementation of Project Operations 8-3
8.2 COST SHARING 8-3
8.2.1 Cost Apportionment 8-4
8.3 PROJECT OPERATIONS 8-4
8.4 PROJECT ASSURANCES 8-5

8.4.1 Level of Service for Flood Protection 8-5
8.4.2 Effects on Legal Sources of Water 8-6
8.4.3 Identification of Water to be Made Available for the Natural System 8-7
8.4.4 Identification of Water for Other Water-Related Needs 8-8
8.5 PROJECT WATER QUALITY MONITORING PLAN 8-9
8.6 ENVIRONMENTAL COMMITMENTS 8-11
8.7 VIEWS OF NON-FEDERAL SPONSOR 8-13

SECTION 9

9.0 SUMMARY OF COORDINATION AND ENVIRONMENTAL COMPLIANCE 9-1
9.1 SCOPING AND DRAFT EIS 9-1
9.2 COORDINATION WITH EXISTING UTILITIES AND PUBLIC INFRASTRUCTURE [373.1501(5)(E)] 9-2
9.2.1 Summary of Utilities and Public Infrastructure within the Project Area 9-2
9.2.2 Summary of Coordination Efforts with Existing Utilities and Public Infrastructure 9-4
9.3 CIRCULATION OF REVISED DRAFT PIR / EIS 9-5
9.4 COMMENTS RECEIVED AND RESPONSES 9-5
9.5 COMPLIANCE WITH ENVIRONMENTAL LAWS, STATUTES AND EXECUTIVE ORDER 9-5
9.6 COMPLIANCE WITH FLORIDA STATUTES AND VIEWS OF NON-FEDERAL SPONSOR 9-6
9.6.1 Clean Air Act of 1972 9-6
9.6.2 Clean Water Act of 1972 9-6
9.6.3 Coastal Zone Management Act of 1972 9-7
9.6.4 National Environmental Policy Act of 1969 9-7
9.6.5 Fish and Wildlife Coordination Act of 1958 9-8
9.6.6 Migratory Bird Treaty Act and Migratory Bird Conservation Act 9-8
9.6.7 Endangered Species Act of 1973 9-9
9.6.8 Magnuson-Stevens Fishery Conservation and Management Act 9-9
9.6.9 Marine Mammal Protection Act of 1972 9-9
9.6.10 Estuary Protection Act of 1968 9-10
9.6.11 National Historic Preservation Act of 1966 (Inter Alia)(PL 89-665, the Archeology and Historic Preservation Act (PL 93-291), and executive order 11593) 9-10
9.6.12 Resource Conservation and Recovery Act of 1976; Toxic Substances Control Act of 1976 9-11
9.6.13 Farmland Protection Policy Act of 1981 9-13
9.6.14 E.O. 11988, Flood Plain Management 9-13
9.6.15 E.O. 11990, Protection of Wetlands 9-13
9.6.16 E.O. 12898, Environmental Justice 9-13
9.6.17 E.O. 13112, Invasive Species 9-14

SECTION 10

10.0 RECOMMENDATIONS 10-1

SECTION 11

11.0 GLOSSARY OF TERMS AND ACRONYMS 11-1
11.1 GLOSSARY OF TERMS 11-1
11.2 ACRONYMS 11-9

SECTION 12

12.0 PREPARERS OF THE PIR 12-1

SECTION 13

13.0 REFERENCES 13-1

SECTION 14

14.0 INDEX 14-1

LIST OF TABLES

Table 1-1: Ongoing projects likely to affect the EAA Storage Reservoirs Project 1-13
Table 2-1: Results of wetland extent field survey of Compartment A by interagency ecological team. 2-13
Table 2-2: List of Protected Species in the Affected Area 2-24
Table 2-3: EAA socioeconomic characteristics 2-45
Table 2-4: Acreage by crop in the EAA. 2-47
Table 2-5: Soil Clean-up Target Levels and SQAGs (Sediment Quality Assessment Goals) 2-55
Table 5-1: Cost per square-foot of water stored. 5-11
Table 5-2: Summary of reservoir alternatives. 5-13
Table 5-3: Alternative 2 design summary. 5-14
Table 5-4: Alternative 3 design summary. 5-15
Table 5-5: Alternatives 4 and 5 design summary. 5-16
Table 5-6: alternative 6 design summary. 5-17
Table 5-7: Seepage canal design summary. 5-21
Table 5-8: Implementation assumptions and schedule of construction. 5-23
Table 5-9: Alternative Plan cost estimates 5-27
Table 5-10: Calculation of costs used in cost-effectiveness analysis ($1000) 5-29
Table 5-11: Effects Evaluation: Categories of Natural and Cultural Resources Effects 5-32
Table 5-12: Area Converted From crops To Reservoirs. 5-35
Table 5-13: Comparison of sugarcane production Lost. 5-35
Table 5-14: RECOVER performance measures used for EAA Storage Reservoirs Project 5-37
Table 5-15: Framework for Ecosystem Condition Benchmarks 5-41
Table 5-16: EFfect of alternative implementation upon benefits. 5-47
Table 5-17: WRAP scores for seepage buffer habitat. 5-48
Table 5-18: WRAP scores for littoral shelf habitat. 5-48
Table 5-19: Habitat units for environmentally responsible design features. 5-48
Table 5-20: Evaluation Matrix 5-54
Table 5-21: Ecological outputs (average annual habitat units) used for CE/ICA 5-63
Table 5-22: Results of cost-effectiveness analysis. 5-63
Table 5-23: Results of incremental cost analysis: cost effective and best bUy plans arrayed by increasing output for combined habitat (all plans). 5-65
Table 5-24: Habitat units for Lake Okeechobee high water performance measures (PMs) (LO-E3 and LO-E10 SA) for the five wettest years from the modeling period of record. 5-68
Table 5-25: Volume of backpumping in acre-feet from the Everglades Agricultural Area into Lake Okeechobee through the S-2 and S-3 pump structures for EAASR project alternatives. 5-68
Table 5-26: Habitat units for St. Lucie Estuary for performance measure of reduction in Lake Okeechobee regulatory releases (LORR) from the modeling period of record. 5-69
Table 5-27: Categorized data for the Caloosahatchee Estuary Performance Measure. 5-69

Table 6-1: Reservoir Design Elevations 6-3
Table 6-2: Cell 1 Reservoir Storage Calculations..... 6-3
Table 6-3: Cell 2 Reservoir Storage Calculations..... 6-3
Table 6-4: Wetlands Buffer and littoral zone 6-13
Table 6-5: Summary of Recreation Costs and Benefits..... 6-14
Table 6-6: Project Cost EAA Reservoir Alternative 4..... 6-15
Table 6-7: Total interest during construction..... 6-16
Table 6-8: OMRR&R Cost Estimates..... 6-17
Table 6-9: Average Annual Cost 6-17
Table 6-10: Selected Plan Costs 6-17
Table 8-1: Cost Appointment of the 12-Foot Deep Earthen Embankment Plan 8-4
Table 8-2: Summary of Monitoring Program For CERP EAA Reservoir..... 8-10

LIST OF FIGURES

Figure 1-1: Major CERP Features 1-12
Figure 1-2: Location of the EAA 1-15
Figure 1-3: The EAA and Vicinity 1-16
Figure 2-1: Existing Primary and Secondary Agricultural Canals in the Everglades Agricultural Area..... 2-4
Figure 2-2: 1999-2000 FWC Land Cover within the Everglades Agricultural Area 2-12
Figure 2-3: Census Tracts in the Everglades Agricultural Area and Vicinity 2-43
Figure 2-4: Existing Bridges, Roads and Structures within the EAA Storage Reservoir Region 2-58
Figure 5-1: Alternative 2 design layout. 5-14
Figure 5-2: Alternative 3 Design Layout 5-15
Figure 5-3: Alternatives 4 and 5 Design Layout..... 5-16
Figure 5-4: Alternative 6 Design Layout 5-17
Figure 5-5: Typical Earthen Levee Section 5-18
Figure 5-6: Typical RCC Levee Section..... 5-19
Figure 5-7: Ecological benefits for Lake Okeechobee. 5-43
Figure 5-8: Ecological benefits for St. Lucie Estuary..... 5-44
Figure 5-9: Ecological benefits for Caloosahatchee Estuary. 5-45
Figure 5-10: Ecological benefits for Ridge and Slough habitats. 5-46
Figure 5-11: Ecological benefits for Tree Island Habitat. 5-46
Figure 5-12: EAA Alternative Plans – CE/ICA Run on Combined Average Annual Habitat Units for all alternatives. 5-64
Figure 5-13: EAA Cost Effective Plans – CE/ICA Run on all Alternatives. 5-64
Figure 5-14: Incremental cost analysis. cost effective and best buy plans 5-65
Figure 6-1: Project Area..... 6-2
Figure 6-2: Design Layout 6-4
Figure 6-3: Bolles and Cross Canals..... 6-10
Figure 6-4: Conceptual Cross-Section of the EAA Project Footprint Including the Seepage/Habitat Buffer and Littoral Shelves 6-12
Figure 6-5: Everglades Agricultural Area Conceptual Recreation Plan..... 6-14

This page intentionally left blank.

SECTION 1
INTRODUCTION

This page intentionally left blank

1.0 INTRODUCTION

The Central and Southern Florida (C&SF) Project Comprehensive Review Study, known as the "Restudy", was authorized by Section 309(l) of the Water Resources Development Act of 1992 (P.L.102-580). This study was also authorized by two resolutions of the Committee on Transportation and Infrastructure, United States House of Representatives, dated September 24, 1992. Section 528 of the Water Resources Development Act of 1996 provides specific direction and guidance for the Restudy.

The purpose of the Restudy was to reexamine the C&SF Project to determine the feasibility of modifying the project to restore the South Florida ecosystem and to provide for the other water-related needs of the region. Specifically, as required by the authorizing legislation, the study investigated making structural or operational modifications to the C&SF Project for improving the quality of the environment; protecting water quality in the South Florida ecosystem; improving protection of the aquifer; improving the integrity, capability, and conservation of urban and agricultural water supplies; and, improving other water-related purposes. The Restudy recommended the Comprehensive Everglades Restoration Plan (CERP) which identified 68 components, individually focused at the local scale; however, ultimately benefiting the entire Everglades ecosystem. The Everglades Agricultural Area (EAA) Storage Reservoirs Project is one of these components.

1.1 REPORT AUTHORITY

The EAA Storage Reservoirs study was authorized by the Water Resources Development Act of 2000 (WRDA 2000). Congress approved the CERP as the "framework for modifications and operational changes to the Central and Southern Florida Project (C&SF) that are needed to restore, preserve and protect the South Florida ecosystem while providing for other water-related needs of the region, including water supply and protection (WRDA 2000)."

The direction and guidance for this project is contained within the CERP Master Program Management Plan which was developed and approved by the U.S. Army Corps of Engineers (USACE) and the South Florida Water Management District (SFWMD). The USACE and SFWMD subsequently executed an Agreement for the Design of Elements of the Comprehensive Plan for the Everglades and South Florida Ecosystem Restoration Project (Design Agreement) in May 2000, which outlined each party's cooperation and contribution requirements for CERP design, including this project.

The EAA Storage Reservoirs Project, as envisioned in this Project Implementation Report (PIR)/Environmental Impact Statement (EIS), is substantially similar to the project that was envisioned in the CERP as

authorized per Section 601(b)(2)(C)(ii) of WRDA 2000. However, the project has undergone design refinements due to external issues such as land availability and dam safety requirements. The PIR will address cost-effectiveness, engineering feasibility, and potential environmental impacts of the project. Formulation and evaluation of the alternative plans will be part of the PIR. The plan formulation optimizes the project's contributions towards achieving the goals and purposes of the CERP. This is summarized in Section 5 of this document.

The National Environmental Policy Act of 1969 (NEPA), as amended, is the nation's charter for environmental protection. NEPA establishes policy, sets goals, and provides means for carrying out the policy. Section 102(2) of the Act contains action-forcing provisions to make sure that Federal agencies act according to the letter and spirit of the Act, including a provision to prepare a detailed statement, now called an EIS, on the effects of a proposed Federal action. The Federal regulations for implementing the procedural provisions of NEPA were published by the Council on Environmental Quality (CEQ) in the Code of Federal Regulations (CFR) as 40 CFR Parts 1500-1508 (43 Federal Register 55978-56007, November 29, 1978).

USACE Regulation 200-2-2 provides guidance for implementation of the procedural provisions of NEPA. It supplements CEQ regulations in accordance with 40 CFR 1507.3 and is intended to be used only in conjunction with the CEQ regulations. NEPA requires preparation of an EIS for authorization and construction of major projects.

This study is being presented as an integrated PIR/EIS. Detailed results of the many independent studies and investigations conducted are attached as appendices. Interrelated summaries and important observations resulting from these independent studies and investigations are used and encapsulated throughout the main body of the report.

1.1.1 Project Authorization

Along with the C&SF Study, the study is authorized by Section 309(l) of the *Water Resources Development Act of 1992* (Public Law 102-580) which states:

"(1) CENTRAL AND SOUTHERN FLORIDA. -- The Chief of Engineers shall review the report of the Chief of Engineers on central and southern Florida, published as House Document 643; 80th Congress, 2nd Session, and other pertinent reports, with a view to determining whether modifications to the existing project are advisable at the present time due to significantly changed physical, biological, demographic, or economic conditions, with particular reference to modifying the project or its operation for improving the quality of the

environment, improving protection of the aquifer, and improving the integrity, capability, and conservation of urban water supplies affected by the project or its operation."

This study is also authorized by two resolutions of the Committee on Transportation and Infrastructure, United States House of Representatives, dated September 24, 1992. The first resolution states:

"Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Board of Engineers for Rivers and Harbors, is requested to review the report of the Chief of Engineers on Central and Southern Florida, published as House Document 643, Eightieth Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of environmental quality, water supply and other purposes."

The second resolution states:

"Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Board of Engineers for Rivers and Harbors, is requested to review the report of the Chief of Engineers on Central and Southern Florida, published as House Document 643, Eightieth Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of environmental quality, water supply and other purposes for Florida Bay, including a comprehensive, coordinated ecosystem study with hydrodynamic modeling of Florida Bay and its connections to the Everglades, the Gulf of Mexico, and the Florida Keys Coral Reef ecosystem."

The *Water Resources Development Act of 1996* was enacted on October 12, 1996. Section 528 of the Act (Public Law 104-303) entitled "Everglades and South Florida Ecosystem Restoration" authorizes a number of ecosystem restoration activities and also provides specific direction and guidance for the CERP.

(b) RESTORATION ACTIVITIES-

1. *COMPREHENSIVE PLAN-*
   - *A. DEVELOPMENT-*
     - i. *PURPOSE- The Secretary shall develop, as expeditiously as practicable, a proposed Comprehensive Plan for the purpose of restoring, preserving, and protecting the South Florida ecosystem. The Comprehensive Plan shall provide for the protection of water quality in, and the reduction of the loss of fresh water from, the Everglades. The Comprehensive Plan shall include such features as are necessary to provide for the water-related needs of the region,*

including flood control, the enhancement of water supplies, and other objectives served by the Central and Southern Florida Project.

ii. *CONSIDERATIONS- The Comprehensive Plan shall—*

(I) Be developed by the Secretary in cooperation with the non-Federal project sponsor and in consultation with the Task Force; and

(II) Consider the conceptual framework specified in the report titled "Conceptual Plan for the Central and Southern Florida Project Restudy," published by the Commission and approved by the Governor.

D. SUBMISSION- Not later than July 1, 1999, the Secretary shall—

i. *Complete the feasibility phase of the Central and Southern Florida Project comprehensive review study as authorized by section 309(l) of the Water Resources Development Act of 1992 (106 Statue. 4844), and by two resolutions of the Committee on Public Works and Transportation of the House of Representatives, dated September 24, 1992; and*

ii. *Submit to Congress the plan developed under subparagraph (A)(i) consisting of a feasibility report and a programmatic environmental impact statement covering the proposed Federal action set forth in the plan.*

E. ADDITIONAL STUDIES AND ANALYSES- Notwithstanding the completion of the feasibility report under subparagraph (B), the Secretary shall continue to conduct such studies and analyses as are necessary, consistent with subparagraph (A)(i).

In Section 601 of the Water Resources Development Act of 2000 (PL 106-541), Congress approved the C&SF Project Comprehensive Review Study Integrated Feasibility Report and Programmatic Environmental Impact Statement (known as the "Restudy"), which describes and outlines the CERP:

(b) Comprehensive Everglades Restoration Plan –

1. *Approval -*

A. IN GENERAL. — Except as modified by this section, the Plan is approved as a framework for modifications and operational changes to the Central and Southern Florida Project that are needed to restore, preserve, and protect the South Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection. The Plan shall be implemented to ensure the protection of water quality in, the reduction of the loss of fresh water from, and the improvement of the environment of the South Florida ecosystem and to achieve and maintain the benefits to the natural system and human environment described in the Plan, and required pursuant to this section, for as long as the project is authorized.

The Everglades Agricultural Area Storage Reservoir, Phase 1 consisting of a 240,000 acre-foot reservoir was one of the initial 10 projects authorized for implementation in Section 601(b)(2)(C) of WRDA 2000.

2. *SPECIFIC AUTHORIZATIONS -*
   C. *INITIAL PROJECTS. — The following projects are authorized for implementation, after review and approval by the Secretary, subject to the conditions stated in subparagraph (D), at a total cost of $1,100,918,000, with an estimated Federal cost of $550,459,000 and an estimated non-Federal cost of $550,459,000:*
      ii. Everglades Agricultural Area Storage Reservoirs--Phase I, at a total cost of $233,408,000, with an estimated Federal cost of $116,704,000 and an estimated non-Federal cost of $116,704,000.
   D. *CONDITIONS.—*
      i. PROJECT IMPLEMENTATION REPORTS. — Before implementation of a project described in any of clauses (i) through (x) of subparagraph (C), the Secretary shall review and approve for the project a project implementation report prepared in accordance with subsections (f) and (h).
      ii. SUBMISSION OF REPORT. —The Secretary shall submit to the Committee on Transportation and Infra-structure of the House of Representatives and the Committee on Environment and Public Works of the Senate the project implementation report required by sub-sections (f) and (h) for each project under this paragraph (including all relevant data and information on all costs).
      iii. FUNDING CONTINGENT ON APPROVAL. —No appropriation shall be made to construct any project under this paragraph if the project implementation report for the project has not been approved by resolutions adopted by the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Environment and Public Works of the Senate.

Finally, Section 601(h)(4) of WRDA 2000 further requires that PIRs document:

4. *PROJECT-SPECIFIC ASSURANCES-*
   A. PROJECT IMPLEMENTATION REPORTS-
      i. IN GENERAL- The Secretary and the non-Federal sponsor shall develop project implementation reports in accordance with section 10.3.1 of the Plan.
      ii. COORDINATION- In developing a project implementation report, the Secretary and the non-Federal sponsor shall coordinate with appropriate Federal, State, tribal, and local governments.
      iii. REQUIREMENTS- A project implementation report shall--

(I) be consistent with the Plan and the programmatic regulations promulgated under paragraph (3);
(II) describe how each of the requirements stated in paragraph (3)(B) is satisfied;
(III) comply with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.);
(IV) identify the appropriate quantity, timing, and distribution of water dedicated and managed for the natural system;
(V) identify the amount of water to be reserved or allocated for the natural system necessary to implement, under State law, subclauses (IV) and (VI);
(VI) comply with applicable water quality standards and applicable water quality permitting requirements under subsection (b)(2)(A)(ii);
*(VII) be based on the best available scie*nce; and
(VIII) include an analysis concerning the cost-effectiveness and engineering feasibility of the project.

1.2 PURPOSE AND SCOPE

The Everglades ecosystem stretches from Orlando through the Kissimmee Chain of Lakes to Florida Bay. The goals and objectives of the Restudy include:

Enhance Ecologic Values

- Increase the total spatial extent of natural areas
- Improve habitat and functional quality
- Improve native plant and animal species abundance and diversity

Enhance Economic Values and Social Well Being

- Increase availability of fresh water (agricultural/municipal & industrial)
- Reduce flood damages (agricultural/urban)
- Provide recreational and navigation opportunities
- Protect cultural and archeological resources and values

The EAA Storage Reservoirs Project would contribute to the goals and objectives of the Restudy by:

- Reducing damaging high lake stages in Lake Okeechobee and regulatory releases to the estuaries, thereby contributing to an increase in species diversity and productivity within the lake littoral zone and in the estuaries;
- Reducing in back-pumping of from the EAA into Lake Okeechobee, thereby contributing to an improvement in water quality in the lake;

- Storing of water during the wet season and releasing it to the Everglades during the dry season, thereby contributing to improvements that benefit water quality and hydro-patterns in the Everglades;
- Improving flow equalization, by capturing peak storm events in the reservoir for slow release to the Stormwater Treatment Areas (STAs), thereby improving STA treatment performance, habitat and functional quality, and native plant and animal species abundance and diversity; and,
- Providing a water storage facility for agricultural runoff, water supply and flood protection, thereby improving the Lake's ability to operate in a more environmentally sustainable manner.

The goals and objectives of the EAA Storage Reservoirs Project include:

Habitat Restoration in Lake Okeechobee

- Restore lake littoral zone hydro-patterns
- Restore lake water quality
- Restore lake littoral zone habitat functional quality
- Restore lake littoral zone native plant and animal abundance and species diversity

Habitat Restoration in the Caloosahachee and St. Lucie Estuaries

- Restore estuary hydro-patterns
- Restore estuary water quality
- Restore estuary habitat functional quality
- Restore estuary native plant and animal abundance and species diversity

Habitat Restoration in the Everglades Protection Area

- Restore Everglades hydro-patterns
- Restore Everglades water quality
- Restore Everglades habitat functional quality
- Restore Everglades native plant and animal abundance and species diversity

The Restudy proposed the construction of above-ground reservoirs and conveyance improvements within the EAA. The reservoirs would meet the project objectives by reducing EAA irrigation demands on Lake Okeechobee, by capturing regulatory releases from the lake, and by improving the timing of environmental water deliveries the Water Conservation Areas (WCA). Simply expressed, the EAA reservoir would reduce withdrawals from Lake Okeechobee for irrigation during the dry season; store some excess runoff water so that it does not contribute to lake level rises during the wet season, and thereby reduce the magnitude of fluctuations in Lake Okeechobee water levels; taking the

highest peaks off discharges to the eastern and western estuaries; and reducing the range of lake levels by several inches.

Improvements to conveyance capacity in the Miami and North New River Canals between Lake Okeechobee and the storage reservoir would be required to convey additional Lake Okeechobee releases. Increased conveyance capacity of the Bolles and Cross Canals between the Miami and Hillsboro Canals will also be required to provide conveyance of reservoir agricultural water deliveries and to allow inter-basin transfers to capture basin runoff.

For the purposes of plan formulation and in accordance with the language of the Programmatic Regulations, the term "selected plan" is used throughout this document to refer to the alternative selected for recommendation of implementation. For the purposes of complying with NEPA implementing regulations and in the spirit of NEPA, the plan that would be recommended for authorization is termed the "preferred alternative." For NEPA, a plan is not "selected" until it has been fully coordinated, subject to revisions based on public involvement, then formally accepted by Congress or the Chief of Engineers, as appropriate, and selected at the signing of a Record of Decision (ROD) or FONSI. Throughout this document, the analysis includes the NEPA evaluation, and uses the term "selected alternative" or "selected plan" interchangeably with the preferred alternative. "Selected" throughout this document is meant to discern which alternative the District Engineer of the Corps of Engineers recommends to Congress or Chief of Engineers for further development and implementation.

1.3 PRIOR STUDIES, REPORTS, AND PROJECTS

1.3.1 Flood Control Act of 1948

In 1947, 100 inches of rain fell on South Florida, more than tripling the region's total rainfall for 1945 and ending one of the worst droughts in Florida history. In a few weeks, the rain had drenched farmland and filled lakes and canals. Then in the space of just 25 days, two hurricanes and a tropical disturbance placed more water on an already saturated area.

Acting upon the requests of many local agencies concerned with flood control and water conservation, and under the authority of various flood control acts, river and harbor acts of Congress, and resolutions of appropriate congressional committees, USACE Jacksonville District conducted public hearings throughout the area to determine the desires of the many local interests and to collect data from which to formulate a plan.

A comprehensive report was prepared by USACE and submitted to higher authority on December 19, 1947. This report stated that the problems of flood

protection, drainage, and water control were considered to be physically interrelated, and that the St. Johns, Kissimmee, Lake Okeechobee, Caloosahatchee, and Everglades drainage areas all formed a single economic unit. Accordingly, it recommended a comprehensive program in the interest of "flood control, drainage and related purposes." Congress approved the plan as part of the Flood Control Act of June 30, 1948, and the report was published in House Document No. 643, 80th Congress, Second Session.

The Governor of Florida approved the plan for the State of Florida in February 1948. The following year, the Florida Legislature formed the Central and Southern Florida Flood Control District, later to become SFWMD, to act as a single agency with which the Federal government could deal on all matters of local cooperation. Construction of the Federal project began in January 1950.

1.3.2 Flood Control Act of 1954

The C&SF Project, first phase, was authorized by the Flood Control Act of June 30, 1948, for the purposes of flood control, water level control, water conservation, prevention of salt water intrusion, and preservation of fish and wildlife. The first phase consisted of most of the works necessary to afford flood protection to the agricultural development south of Lake Okeechobee and to the highly developed urban area along the lower East Coast of the state. The second phase, consisting of all remaining works of the original Comprehensive Plan, was authorized by the Flood Control Act of September 3, 1954.

1.3.3 Flood Control Acts of 1958, 1960, 1962, and 1965

Improvements in Hendry County and Nicodemus Slough (just west of Lake Okeechobee) were added to the project by the Flood Control Acts of July 3, 1958, and July 14, 1960, respectively. Improvements in Boggy Creek, Cutler Drain Area, Shingle Creek, South Miami-Dade County, and West Palm Beach Canal were added to the project by the Flood Control Act of October 23, 1962. Improvements in southwest Miami-Dade County were added to the project by the Flood Control Act of October 27, 1965. The same Act also modified the 1958 authorization for the Hendry County improvements.

1.3.4 Flood Control Act of 1968

The Flood Control Act of 1968 expanded the project to provide for increased storage and conservation of water and for improved distribution of water throughout much of the project area and added recreation as a project purpose. Flood control measures for Martin County were added. The 1968 modifications increased delivery of water to Everglades National Park.

1.3.5 Public Law 91-282

Section 2 of Public Law 91-282 enacted June 19, 1970, authorized appropriations for USACE to accelerate developing means to meet the water requirements of the Everglades National Park (ENP). It also specified the minimal amount of water that was to be delivered to the Park each year.

1.3.6 Everglades National Park Protection and Expansion Act of 1989

Section 104 of the Everglades National Park Protection and Expansion Act of 1989 (Public Law 101-229) directed USACE:

"to construct modifications to the Central and Southern Florida Project to improve water deliveries into the park and shall, to the extent practicable, take steps to restore the natural hydrological conditions within the park."

In accordance with Public Laws 91-282 and 101-229, the project also delivers water to ENP according to a set schedule.

1.3.7 Water Resources Development Act of 1992

The Water Resources Development Act of 1992 (Public Law 102-580) authorized modifications to the C&SF Project for ecosystem restoration of the Kissimmee River. Both the Kissimmee River Restoration and the Headwaters Revitalization Projects were authorized.

1.3.8 Water Resources Development Act of 2000 (WRDA 2000)

The implementation of the CERP was established as a national priority with the approval of the WRDA 2000. Congress approved the CERP as the "framework for modifications and operational changes to the Central and Southern Florida (C&SF) Project that are needed to restore, preserve, and protect the South Florida ecosystem while providing for other water- related needs of the region, including water supply and flood protection." The primary purpose of the CERP is the restoration of the Everglades ecosystem, including specific safeguards to ensure that the benefits to the natural system are achieved and maintained, while providing for other water-related needs of the South Florida region.

1.3.9 Other Studies, Reports, and Projects

The CERP is comprised of 68 major components, which are grouped into over 40 projects (Figure 1-1). The projects are related to the EAA Storage Reservoir project as they all work together to achieve CERP goals.

Details on projects, studies, and program documents can be found on the Internet at www.evergladesplan.org/pm/landing_pp.cfm. Projects of particular relevance to the EAA Storage Reservoirs Project are:

- C-43 Basin Aquifer Storage and Recovery - Part 2,
- C-43 Basin Storage Reservoir - Part 1,
- Caloosahatchee Backpumping with Stormwater Treatment,
- Caloosahatchee River (C-43) Basin Aquifer Storage & Recovery Pilot,
- Everglades Agricultural Area Storage Reservoirs - Phase 2,
- Flow to Northwest & Central Water Conservation Area 3A,
- Henderson Creek / Belle Meade Restoration,
- Indian River Lagoon – South,
- Lake Okeechobee Aquifer Storage & Recovery,
- Lake Okeechobee Aquifer Storage & Recovery Pilot,
- Lake Okeechobee Watershed,
- Modify Holey Land Wildlife Management Area Operation Plan,
- Modify Rotenberger Wildlife Management Area Operation Plan,
- Water Conservation Area - 2B Flows To Everglades National Park,
- Water Conservation Area - 3A / 3B Flows To Central Lake Belt (CLB),
- Water Conservation Area 3 Decompartmentalization & Sheet Flow Enhancement - Part 1,
- Water Conservation Area 3 Decompartmentalization & Sheet Flow Enhancement - Part 2.

SFWMD has undertaken the development of regional and sub-regional level water supply plans to provide for better management of South Florida's water resources. The Lower West Coast Water Supply Plan was completed in February 1994 (SFWMD, 1994b). The Interim Plan for Lower East Coast Regional Water Supply (SFWMD, 1998d), which addresses water related needs and concerns of southeastern Florida through the year 2010, and the Upper East Coast Water Supply Plan (SFWMD, 1998b), which evaluates future 2020 water demands and supplies for the Upper East Coast of Florida, were completed in 1998. A Lower East Coast Plan with a 2010 horizon was developed in 2000 (SFWMD, 2000).

Table 1-1 lists other projects or features that may affect the EAA Storage Reservoir Project.

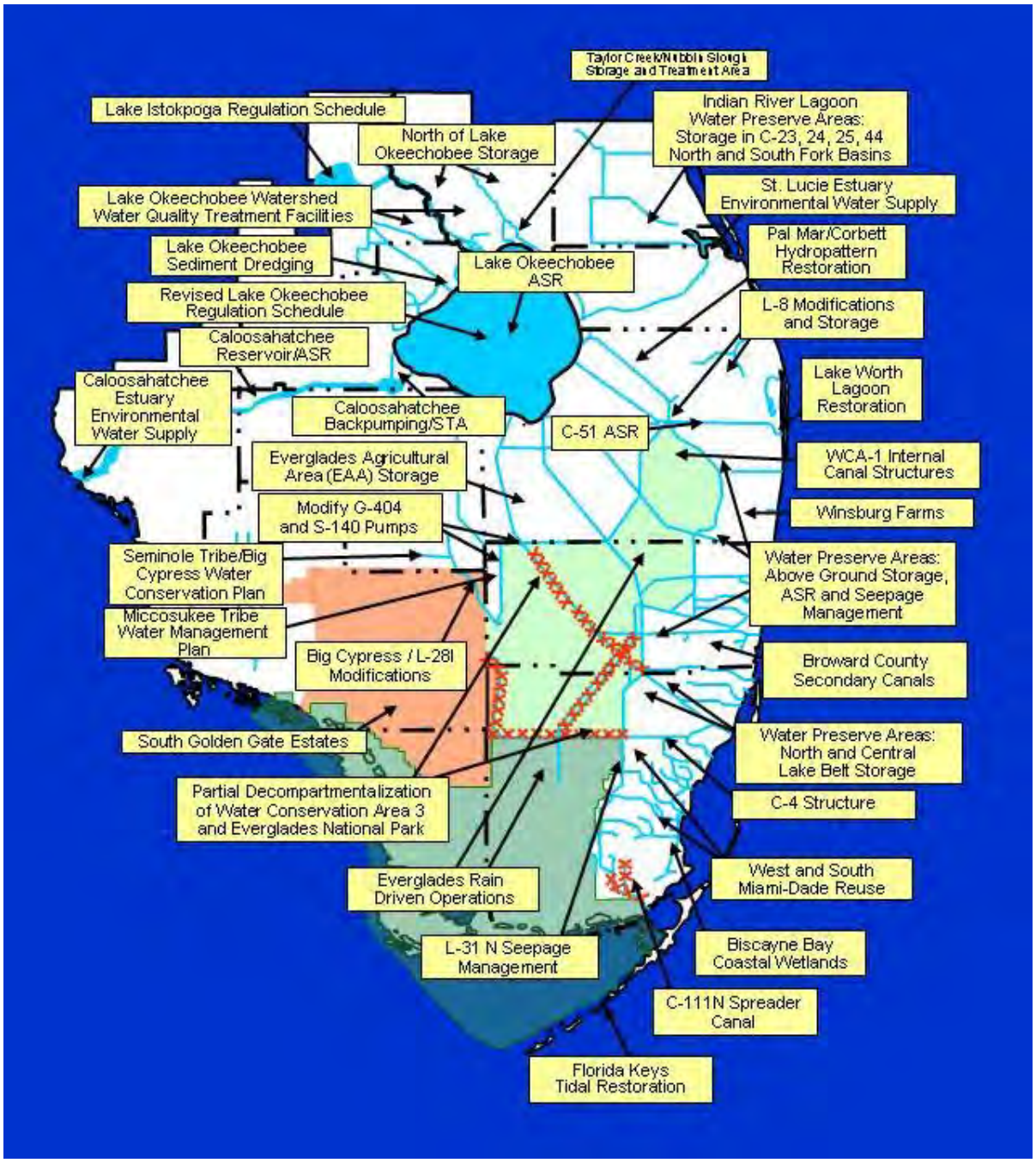
Taylor Creek/Nubbin Slough Storage and Treatment Area
Lake Istokpoga Regulation Schedule
North of Lake Okeechobee Storage
Indian River Lagoon Water Preserve Areas: Storage in C-23, 24, 25, 44 North and South Fork Basins
Lake Okeechobee Watershed Water Quality Treatment Facilities
St. Lucie Estuary Environmental Water Supply
Lake Okeechobee Sediment Dredging
Pal Mar/Corbett Hydropattern Restoration
Lake Okeechobee ASR
Revised Lake Okeechobee Regulation Schedule
L-8 Modifications and Storage
Caloosahatchee Reservoir/ASR
Lake Worth Lagoon Restoration
Caloosahatchee Estuary Environmental Water Supply
Caloosahatchee Backpumping/STA
C-51 ASR
Everglades Agricultural Area (EAA) Storage
WCA-1 Internal Canal Structures
Modify G-404 and S-140 Pumps
Winsburg Farms
Seminole Tribe/Big Cypress Water Conservation Plan
Water Preserve Areas: Above Ground Storage, ASR and Seepage Management
Miccosukee Tribe Water Management Plan
Big Cypress / L-28I Modifications
Broward County Secondary Canals
South Golden Gate Estates
Water Preserve Areas: North and Central Lake Belt Storage
Partial Decompartmentalization of Water Conservation Area 3 and Everglades National Park
C-4 Structure
Everglades Rain Driven Operations
West and South Miami-Dade Reuse
L-31 N Seepage Management
Biscayne Bay Coastal Wetlands
C-111N Spreader Canal
Florida Keys Tidal Restoration

FIGURE 1-1: MAJOR CERP FEATURES

TABLE 1-1: ONGOING PROJECTS LIKELY TO AFFECT THE EAA STORAGE RESERVOIRS PROJECT

Finish Date	Project Name	Description
SFWMD Long-Term Plan (B&M 2003)		
2006	STA-1E	Convert downstream cells to SAV.
2006	STA-1W	Additional compartmentalization, improved flow control, convert additional cells to SAV, identify and implement BMPs.
2006	STA-2	Additional compartmentalization, convert additional cells to SAV, identify and implement BMPs.
2006	STA-3/4	Additional compartmentalization, convert additional cells to SAV, identify and implement BMPs.
2006	STA-5	Improved management and control of seepage, improved flow control, convert additional cells to SAV, identify and implement BMPs.
2006	STA-6	Additional compartmentalization, improved flow control, add water supply capability, convert additional cells to SAV, identify and implement BMPs.
Everglades Regulatory Program (McGinnes, et al. 2004)		
2006	C-139 Basin	Incorporation of BMPs.
2006	EAA	Continuation of BMPs.
SFWMD Draft Adaptive Implementation Strategy (SFWMD 2004)		
2006	STA-2	Expand with a fourth parallel cell of 2,015 acres and defer the planned enhancements.
2006	STA-5	Expand with a third parallel flow-way of 2,560 acres.
2006	STA-6	Construct section 2 with enhancements and defer Section 1 enhancements.
2006	Compartments B&C	Conduct a regional feasibility study to determine the best use for the remaining portions of Compartments B&C (e.g., adding redundancy to the STAs, reducing TP, integrating Snail Farm property, connect Compartment C to Miami Canal, flow equalization, increased water supply, improve L-7 and L-40 conveyance to minimize effect on Refuge).
2006	EAA Regional Feasibility Study	Conduct a regional feasibility study to determine the optimum interbasin transfer alternatives within the EAA.

BMP: Best Management Plan
CERP: Comprehensive Everglades Restoration Plan
SAV: Submersed Aquatic Vegetation
SFWMD: South Florida Water Management District
STA: Stormwater Treatment Area
TP: Total Phosphorus
USACE: U.S. Army Corps of Engineers
WMA: Water Management Area

Sources: Burns & McDonald, 2003.
McGinnes, et. al., 2004.
SFWMD, 2004.

1.4 PROJECT AREA

1.4.1 Primary Study Area/Everglades Agricultural Area

The EAA is located south of Lake Okeechobee in western Palm Beach County and encompasses approximately 620,797 acres of highly productive agricultural land comprised of rich organic peat or muck soils (Figure 1-2). A small portion of the Study Area includes mucklands located in western Martin County. Approximately 77% of the Study Area (553,000 acres) is in agricultural production - now considered one of Florida's most important agricultural regions for cultivation of sugar cane. The Study Area extends south from Lake Okeechobee to the northern levee of WCA-3A. The eastern boundary extends to the L-8 Canal. The L-1, L-2, and L-3 levees represent westernmost limits. Throughout this report the terms planning area refers to the entire Central and Southern Florida Project, project area refers to the entire EAA basin, and the project footprint includes those lands upon which by project features are constructed.

1.4.2 Land Available for Everglades Restoration activities

Consistent with several environmental studies, federal and state laws, and recommendations contained in early Restudy planning efforts, about 50,000 acres of land were acquired by the Department of the Interior (DOI) and the SFWMD for the "acquisition of real property within the Everglades ecosystem" in accordance with Section 390 of the Federal Agriculture Improvement and Reform Act of 1996. A Framework Agreement that was entered into between DOI, the Department of the Army, Florida Department of Environmental Protection (FDEP), and SFWMD further states that the "parties expect the prudent use of funds made available under Section 390 will yield a more natural and sustainable ecosystem in South Florida." The agreement provides a framework for the Secretary of Interior to provide Section 390 funds to the other parties for Everglades ecosystem restoration for both the acquisition of real property and the construction of features that were intended to become part of existing or future USACE projects. The agreement provided that except as otherwise provided by law or agreed to by the Secretary of Interior, all Section 390 funds expended would be matched by non-federal funds on a dollar-for-dollar basis. The agreement also provides: "Section 390 funds disbursed for the acquisition of real property or the construction of features shall count as federal funds for cost sharing purposes for Army projects. Funds provided by the non-federal parties to match federal funds provided under Section 390 will be treated as non-federal funds for cost-sharing purposes for Army projects. The value of real estate acquired pursuant to this Article shall be the acquisition cost of such real property for credit purposes under applicable cost-sharing principles."

FIGURE 1-2: LOCATION OF THE EAA

Planning performed during the Restudy did not optimize the design and performance of individual features, including the EAA storage reservoirs. The Restudy recommended the construction of three 20,000-acre above-ground reservoirs with a total storage capacity of 360,000 acre-feet and up to 150% conveyance capacity increases for the Miami and North New River Canals. For modeling purposes, the reservoirs were located between the Miami and North New River Canals adjacent to the northern boundary of STA-3/4 and the Holey Land Wildlife Management Area. The complex negotiations leading up to land acquisition resulted in the acquisition of Compartment A, shown in Figure 1-3. Various site configurations (including both acquired lands and lands that are presently in private ownership) were investigated to determine the most cost-effective solution for the EAA reservoir.

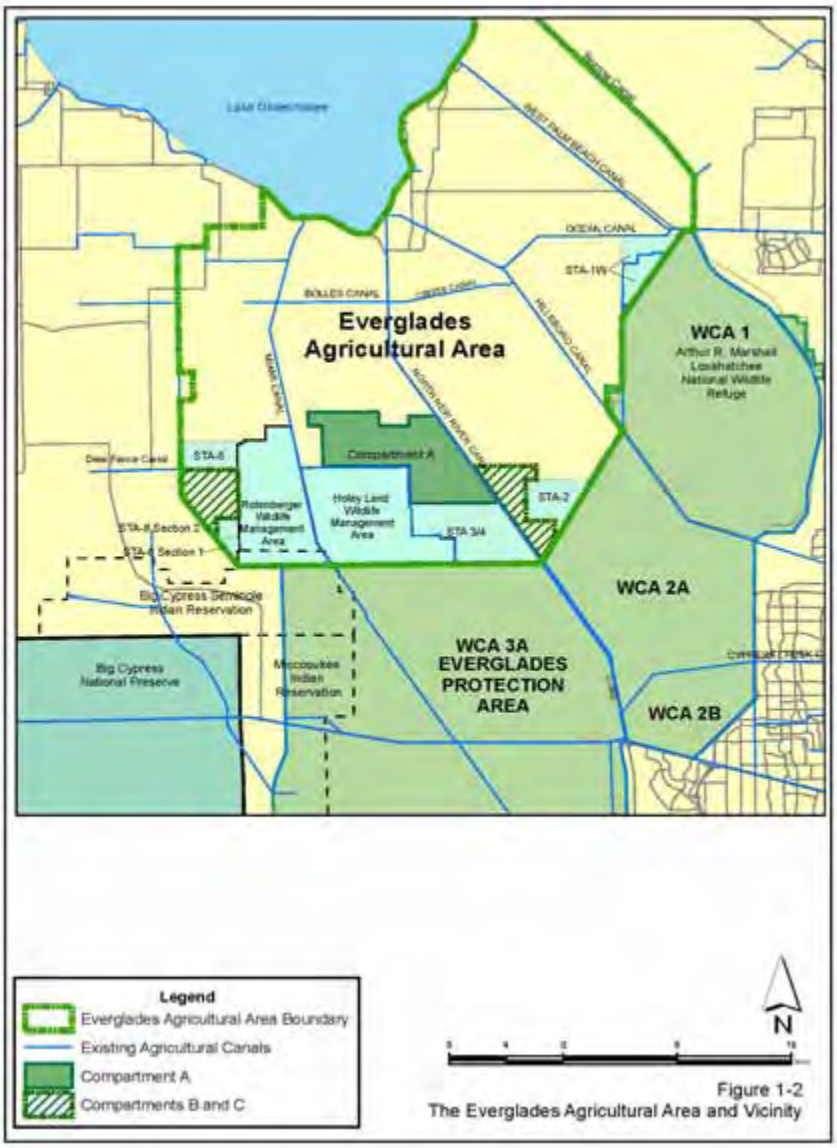

FIGURE 1-3: THE EAA AND VICINITY

1.4.3 Other Areas Affected

Other areas that will be affected by the EAA Storage Reservoir project include: littoral and marsh areas of Lake Okeechobee; the downstream estuaries of St. Lucie Canal (C-44) and the Caloosahatchee River (C-43); the northern WCAs, including WCA-3A north of I-75, WCA-2A; and the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1).

Lake Okeechobee is located in south Central Florida, and occupies portions of Glades, Hendry, Martin, Okeechobee, and Palm Beach Counties. The lake has an area of approximately 700 square miles with its approximate center near 26° 56' 55" north latitude, 80° 56' 34" west longitude.

The St. Lucie Estuary is located within portions of both Martin and St. Lucie Counties on the southeast coast of Florida. The two forks of the St. Lucie Estuary, the North Fork and South Fork, flow together near the Roosevelt Bridge at the City of Stuart, and then flow eastward approximately six miles to the Indian River Lagoon and Atlantic Ocean at St. Lucie Inlet.

The Caloosahatchee River is the only flood-control outlet leading west from Lake Okeechobee. It is part of the Okeechobee Waterway - the only navigable passage in the State of Florida between the Gulf of Mexico and the Atlantic Ocean. The river extends approximately 70 miles from Lake Okeechobee, through the Caloosahatchee River Estuary, to the lower Charlotte Harbor Basin at San Carlos Bay. The Caloosahatchee River passes through parts of Charlotte, Glades, Hendry, and Lee Counties and dips slightly into Collier County.

The three WCAs cover 1,372 square miles and are located south of the Study Area. WCA-1, also known as the Arthur R. Marshall Loxahatchee National Wildlife Refuge, includes 227 square miles of Everglades wetland habitat. WCA-2, the smallest, encompasses approximately 210 square miles. The area is divided into two cells by a levee constructed in 1961. The north cell, WCA-2A, covers 173 square miles, and the south cell, WCA-2B, covers 37 square miles. WCA-3 was originally constructed as one basin covering an area of 915 square miles. It is now divided into WCA-3A and WCA-3B by the L-67 borrow canals which run northeast to northwest across the Broward-Dade County line. WCA-3A has an area of 772 square miles and WCA-3B is 108 square miles.

Prior to the C&SF Project, the entire geographic area was a single large wetland area comprised of sawgrass marshes, wet prairies, aquatic sloughs, and tree island communities- all of which benefited from the expansive sheet flows of water from Lake Okeechobee. Water management issues and problems, prolonged seasonal patterns of water levels (hydroperiods), and increased nutrient levels have resulted in the loss of tree island communities, conversion of

once wet prairies into aquatic sloughs, and conversion of sawgrass marshes into cattails and wet prairie communities.

1.5 PROJECT PARTNERS

For the purposes of NEPA and preparation of this report, SFWMD is the non-Federal sponsor and, as part of the CERP partnership, has several roles as defined in the following Florida Statutes:

- Florida Statute 373.470 (3)(c) requires the completion of a PIR prior to SFWMD entering into a Project Cooperation Agreement with USACE;
- Florida Statute 373.026 (8)(b) requires SFWMD submit a PIR to the FDEP for approval prior to the allocation of funds for the construction of CERP projects; and,
- Florida Statute 373.1501(5) requires SFWMD to analyze and evaluate water supply, water quality, flood protection, threatened and endangered species, and other natural system and habitat needs and to determine that components of the Plan are feasible, efficient, cost-effective, and consistent with CERP purposes.

The missions of USACE are environmental restoration, flood damage reduction, coastal navigation, regulatory permitting, shore protection, water supply, recreation, and emergency management. SFWMD is a regional agency of the State of Florida, and is charged with managing and protecting water resources of the region by balancing and improving water quality, flood control, natural systems and water supply.

While USACE's missions of environmental restoration, flood damage reduction, regulatory permitting and emergency management may affect the project, it is not anticipated that they will detract from the goals and objectives of the EAA Storage Reservoirs Project. It can also be said that SFWMD's missions of balancing and improving water quality, flood damage reduction, natural systems and water supply should have no detrimental effect on the goals and objectives of the EAA Storage Reservoirs Project.

While not officially noted as cooperating agencies for the purposes of NEPA, the following state and federal agencies are members of the EAA Storage Reservoirs Project Team, and have contributed to the development of the PIR/EIS: U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (USEPA), Florida Fish and Wildlife Conservation Commission (FFWCC), and Florida Department of Environmental Protection (FDEP). These agencies are considered to be partners in CERP projects.

1.6 DECISION TO BE MADE

The integrated PIR/EIS provides the documentation and coordination necessary to seek Federal authorization for the selected plan. The PIR describes the economic, environmental, and social benefits and costs of the final array of alternatives and selected alternative plan. The PIR also documents the involvement of Federal agencies, the state of Florida, and other non-Federal entities that have been consulted in the development of the selected alternative plan.

The decision makers must determine if constructing a reservoir and STA and widening associated canals in order to capture Lake Okeechobee releases and treat water delivered to the natural system meets the natural and local water supply demands, reduces the withdrawals from the natural systems, provides proper timing and distribution of water to the WCAs, and reduces freshwater flows to the estuaries. The selected plan must also be consistent with the mission of the agency, cost effective, and in the interest of the Federal and state agencies involved. They must also decide if the location and size of the reservoir and STA is suitable and the impacts acceptable. Included for their review is documentation of the coordination, formulation, and analysis of project benefits and impacts. This project is taken into consideration with other identified CERP, State and National objectives for compliance and prioritization.

This page intentionally left blank

SECTION 2
EXISTING CONDITIONS/AFFECTED ENVIRONMENT

This page intentionally left blank

2.0 EXISTING CONDITIONS/AFFECTED ENVIRONMENT

2.1 HISTORY AND PROCESS FOR DETERMINING EXISTING CONDITIONS

The development of agriculture within the EAA was substantially completed in 1962. Associated with that development was gathering extensive information on soils, crops, water resources, and water management. The proposed EAA reservoirs have been previously considered and studied as part of the C&SF Project and CERP. The documents generated by these studies contain extensive information regarding system-wide existing conditions as well as conditions within the Study Area.

Subsequent to the completion of the Restudy, the EAA Storage Reservoir PIR study was initiated. It focused on advanced plan formulation and design of the proposed reservoirs. Collectively, the information contained in this large body of prior planning efforts, studies, and reports provides documentation of environmental, economic, social, and demographic conditions and serves as the basis for projecting future conditions in the Study Area. In 2003, a South Florida Water Management District (SFWMD)/United States Army Corps of Engineers (USACE) report identified environmental conditions in the CERP Study Area, including the EAA, based on available data (SFWMD, 2003a). These referenced materials were expanded through additional data collection efforts.

A December 2002 SFWMD document defines major basin (drainage basin boundaries) and sub-basin boundaries within the EAA watershed (SFWMD, 2002). These boundaries are continuously changing because of land use changes, land swapping, permit modifications, and other activities within the watershed, as well as the implementation of projects related to the CERP.

USFWS prepared a preliminary report in 2003 on existing conditions in the EAA (USFWS, 2003). This report summarized additional research information and provided the results of a multi-agency wetland habitat verification and the evaluation effort conducted during 2003.

Existing socioeconomic conditions were presented in a 2003 document by SFWMD/USACE. This report focused on socioeconomic data related to EAA agricultural production (SFWMD, 2003b). In January 2004, Dr. George Snyder published a report on EAA soil subsidence and land use projections (Snyder, 2004). This report provided key information about existing conditions for evaluating the future without the project. Information on existing flood control conditions within the Study Area was gathered in 2003. The results were published in February 2004 by SFWMD (SFWMD, 2004).

Wetland Solutions, Inc. authored a water quality assessment report in September 2004 that provided a preliminary assessment of likely water quality impacts of the proposed EAA reservoir, both alone and in combination with STAs. In addition, this report summarized relevant, existing water quality data (USACE, 2004).

The quantity, timing, and distribution of the existing water and changes in water patterns made by the project alternatives features were identified using the South Florida Water Management Model (SFWMM), hydrologic performance measures, and a probabilistic approach utilizing volume probability curves. Hydraulic modeling results were combined with water quality modeling to estimate impacts upon water quality as a result of the alternatives to achieve the proposed action (USACE, 2005).

2.2 GENERAL ENVIRONMENT

This sub-section describes the physical, biological, and human environments of those areas to be affected by the alternatives under consideration. The existing conditions are presented in either a regional or area specific context depending on the nature of the resource or the anticipated effect to that resource.

The EAA encompasses 620,797 acres of mostly existing or former agricultural land. It is located south of Lake Okeechobee, extending to WCAs 1, 2A, 2B, 3A, and 3B on the east and south borders and to the C-139 Basin on the western border. Existing agriculture in the EAA is dominated by sugarcane production with a smaller production of vegetables, rice, and sod.

The EAA contains an extensive network of canals. For the purpose of this report, these canals are divided into three types:

1. Primary - canals that convey water generally from Lake Okeechobee through the EAA to coastal waters. Primary canals include the West Boundary Canal, Miami, Hillsboro, West Palm Beach, L-8 Borrow, and North New River Canals.
2. Secondary - canals that interconnect the primary canals. Secondary canals include the L-1 East, Bolles, Cross, and Ocean Canals.
3. Agricultural - canals that provide water management and control within specific farming operations. Agricultural canals are very numerous and generally unnamed.

The canals within the EAA serve multiple purposes including water routing for water supply for agriculture, flood protection, and water supply for environmental needs. Figure 2-1 shows the system of primary and secondary canals that presently exist within the EAA. The Rotenberger and Holey Land

Wildlife Management Areas (WMA), as well as the STAs, are also contained within the EAA. The reservoir location in the Restudy is within the southern portion of the EAA, north of the Holey Land WMA and SFWMD's STA 3/4. Additional lands, approximately 1,495 acres, which might be added to the project footprint are located adjacent to Compartment A of the Talisman Land Exchange property on the southwestern side, north of Holey Land and east of the Miami Canal.

Surface waters adjacent to the EAA include Lake Okeechobee to the north and the Everglades Protection Area (EPA) to the south and east. Lake Okeechobee is a 730-square mile (1,891 km2) shallow natural lake that was formerly the headwaters of the Everglades. Lake Okeechobee is now entirely enclosed within a water control levee and most surface inflows and outflows, with the exception of precipitation and evapotranspiration, receive some human regulation. There are interior and exterior canals and ditches along almost the entire length of this encircling levee. The WCAs are Everglades wetlands surrounded by levees and water stages are highly managed. These WCAs typically include a rim canal located on the inside of the levees next to the largely undisturbed peat soils and wetland plant communities.

2.3 GEOLOGY, TOPOGRAPHY, AND SOILS

2.3.1 Geology

The EAA developed primarily on top of the Fort Thompson Formation (Pleistocene age), with some Tamiami Formation (Pliocene) in the south. The Fort Thompson Formation is comprised of interbedded sand, shell, and limestone that control the movement of water through the ground in this area (Puri and Vernon, 1964). The geology is not likely to be affected differently under the final array of alternatives to be evaluated, and therefore will not be included in subsequent analyses of the alternatives.

2.3.2 Topography

The topography of the lands surrounding Lake Okeechobee is flat to gently sloping with an elevation ranging from 10 to 20 feet above mean sea level (msl). The area can be divided into three physiographic regions: (1) the Sandy Flatlands to the west and north of the lake which slope gently towards either the lake or the Caloosahatchee Estuary; (2) the Eastern Flatlands to the east of the lake which slope gently towards the lake; and, (3) the Everglades Region to the southeast, south, and southwest of the lake which generally slope to the south away from the lake (Klein et al, 1964; Lichtler, 1960).

The Lake Okeechobee mean water surface elevation is 14.5 feet above mean sea level, although this level varies from one side of the lake to the other depending

upon wind speed and direction. Lake depths within about a mile of the dike range from 1 to 11 feet below the mean water level in natural areas, and are approximately 38 feet below mean water level in the crest canal.

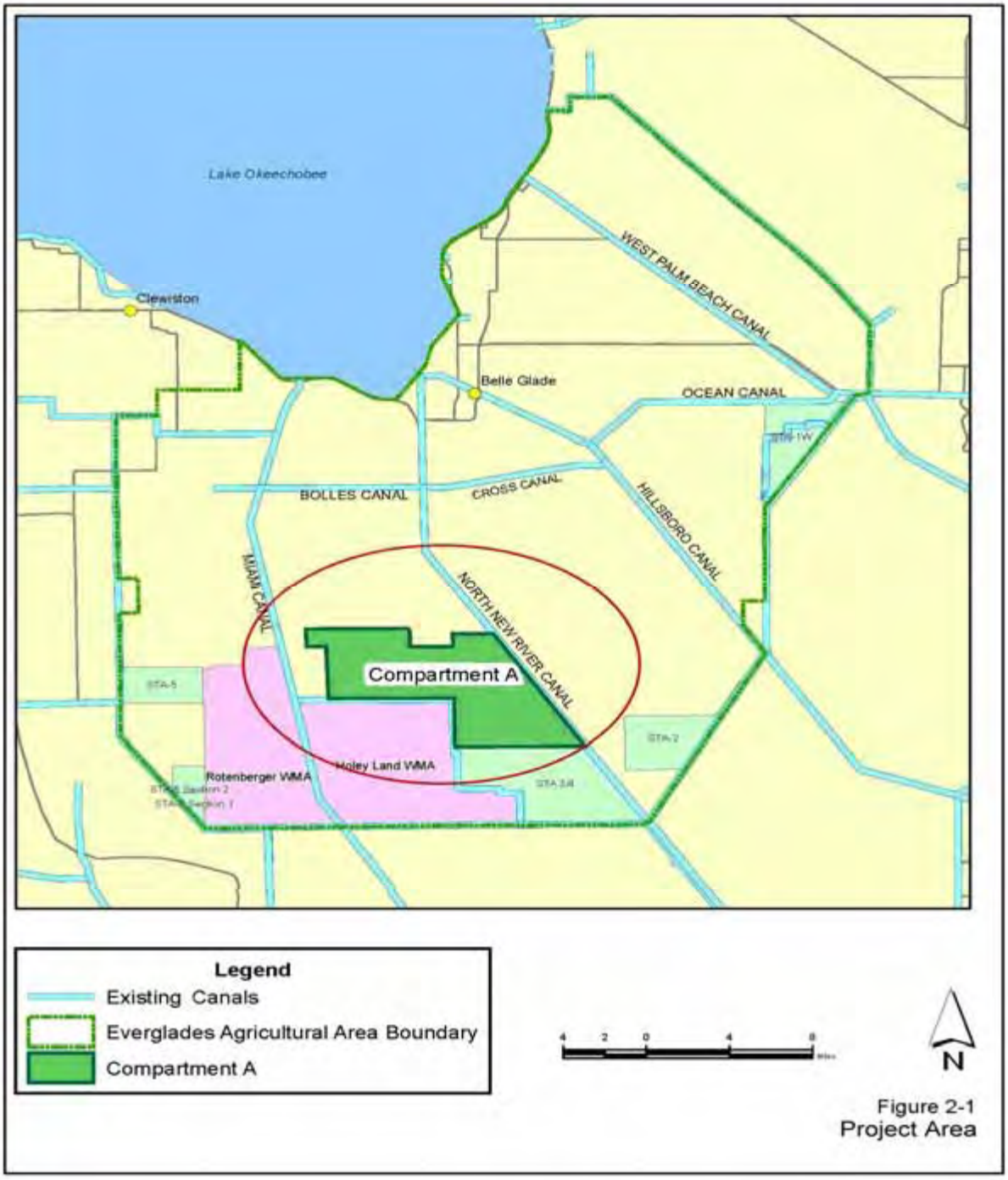

FIGURE 2-1: EXISTING PRIMARY AND SECONDARY AGRICULTURAL CANALS IN THE EVERGLADES AGRICULTURAL AREA

2.3.3 Soils

The EAA is primarily underlain by peat and muck although much of the peat has been altered to muck by oxidation processes. The soils are predominantly organic and contain some fine sands. The EAA is part of what was once the largest region of organic soil in the world with a thickness up to 17 feet. The organic soil is composed of brown to black peat and muck and currently has a maximum thickness of approximately eight feet. The peat was formed primarily from the detritus of native sawgrass. This region of organic soil was formed in a limestone basin, which accumulated layers of peat from sawgrass and mud brought in by fresh water flows from Lake Okeechobee. The peat in the Everglades area ranges in age from approximately 3,600 to 5,250 years (McDowell, et. al., 1969). Wetlands within the EAA contain calcitic mud (marl) soils. This calcitic mud is exposed to short periods of standing water and is often associated with thick algal mats and periphyton.

According to the U.S. Department of Agriculture (USDA) and Natural Resources Conservation Service (NRCS) Soil Survey, 88% of the EAA is comprised of Terra Ceia Muck, Pahokee Muck, Lauderhill Muck and Torry Muck. The remaining 12% contains 44 different types of soils. Eighty-four percent of Compartment A is comprised of Pahokee Muck and Lauderhill Muck. The remaining 16% is comprised of 19 different types of soils.

The agricultural productivity of the soil is affected by subsidence. Peat soils are subjected to subsidence and surface elevation loss when drained. Oxidation is caused by compaction and is the conversion of organic carbon in the soil to carbon dioxide gas and water. It is an irreversible process. Until natural drainage was disrupted, the EAA experienced an annual hydrocycle of 9 to 12 months of flood and 0 to 3 months of slight drainage. The historical sawgrass peat accretion rate is estimated at 0.03 inches per year. Currently, instead of accretion, there has been subsidence at a long-term average rate between 1 and 1.2 inches per year. In the 1900s, soil loss was attributed to aggressive water management Seven hundred thousand acres of the EAA were drained to facilitate agricultural production. Currently, this area is Florida's most important agricultural region with approximately 77% of the EAA devoted to agriculture production.

Studies from 1946 and 1996 suggest that in some areas of the Everglades, one-half of the soil has been lost. The EAA lost up to 28% of its soils. WCA-3, which had 3 to 5 feet of peat in 1946, showed only 1 to 3 feet of peat present in 1996, and some areas had less than one foot. Uncultivated areas have experienced up to three feet of subsidence, which occurs when drainage desaturates the peat soil (Shih, et. al., 1997). The resulting surface soil becomes

less organic which slows the rate of subsidence. The differential rate of subsidence in the past years has altered the slope of the land, which hinders restoration of the natural flow system.

The flat topography, cohesiveness of the peat, and the levee systems allow for little water erosion of the soils in the EAA. In addition, current agricultural practices promote accumulation of chemicals in the soil.

2.3.4 Unique Land Forms

The Everglades itself is a unique geological feature that contains habitats found nowhere else in the world and is referred to as an "American National Treasure." It combines a sub-tropical climate, a broad shallow river and a stunning diversity of plants and animals in a complex and fragile ecosystem. The EAA contains approximately 114 square miles (296 km2), or about 72,944 acres, of wetlands. Therefore, wetlands in the area are an important feature to maintain the desired water quality and provide a habitat for a wide variety of fish and wildlife.

2.4 HYDROLOGY

The groundwater movement is generally toward the north for the western portion of the reservoir site. It is generally toward the southwest for the eastern portion of the reservoir site. The water table is generally at 9.8 ft. During a 30 day simulation that includes a 5-day 25-year storm event, the water table rises to a peak of 11.5 ft.

The western portion of the reservoir site is generally higher than the eastern portion. This topographic configuration produces a surface water movement that is generally toward the east and southeast.

2.4.1 Groundwater

The Lake Okeechobee area contains a surficial aquifer system consisting of all the rocks and sediments from land surface to the top of the limestone. In the EAA, the high organic content of the soil makes the surficial groundwater generally undesirable for domestic use except close to Lake Okeechobee. This aquifer is recharged directly by two sources: Lake Okeechobee and rainfall. Lake Okeechobee provides water for a variety of consumptive demands, including urban drinking water, irrigation for agricultural lands, and recharge for wellfields.

Beneath the surficial aquifer is the Floridan aquifer system. It is the largest aquifer in Florida and the most productive in the world. This system underlies an area of approximately 100,000 square miles (258,999 km2) in Florida,

southeastern Alabama, southern Georgia, and southwestern South Carolina. This aquifer is composed of a thick sequence of limestone layers and is divided into Upper Floridan and Lower Floridan, by a less permeable middle confining unit of carbonates. In the EAA, the water of the Floridan aquifer is rather salty, particularly in the Lower Floridan (Sprinkle, 1989).

2.5 FLOOD PROTECTION LEVEL OF SERVICE

The EAA depends on the flood storage capacity of the WCAs, and to a lesser extent, on Lake Okeechobee, as a means to remove water from the basin. In the case of extreme events such as a hurricane, flood storage in Lake Okeechobee becomes more important. Flood control works on Lake Okeechobee consist of a system of about 1,000 miles (1,600 km) of encircling levees, designed to withstand a severe combination of flood stage and hurricane occurrence, plus the regulatory outlets of St. Lucie Canal and the Caloosahatchee River.

2.6 CLIMATE

2.6.1 General Climate

The climate of the Everglades is characterized by two seasons: the dry and wet seasons. The dry season extends from November to April. The winter weather cold air fronts that often pass through the region weekly bring cool, but rarely freezing, temperatures. At this time of the year, there is low intensity, moderate rainfall with about 25% of the area's annual rainfall of 53 inches occurring during the dry season.

During the wet season, the region experiences daily thunderstorms, intense solar radiation, and high humidity. Seventy-five percent of the rain occurs in this wet season and can include a variable number of extreme rainfall conditions such as hurricanes and tropical storms. The wet season has a bimodal rainfall pattern with one peak between May and June and the second peak between September and October. Every 10 years or so, the region alternates between flood and drought conditions. Annual rainfall, while averaging 53 inches, has ranged from a low of 36 inches to a high of 100 inches.

Mean annual temperature for the South Florida ecosystem ranges from 72°F (22°C) in the northern Everglades to 76°F (24°C) in the south (Thomas, 1974). Mean monthly temperatures range from a low of 63°F (17°C) in January to a high of 85°F (29°C) in August (Thomas, 1974). Infrequently, freezing temperatures and frost occur when arctic air masses follow winter cold fronts into the area.

2.6.2 Evapotranspiration

Evapotranspiration plays an important role in the climate of the South Florida ecosystem and removes between 70% and 90% of the rainfall in undisturbed South Florida wetlands (Duever, et. al., 1994). Evaporation from open water surfaces peaks annually in the late spring when temperatures and wind speeds are high and relative humidity is low. Evaporation is lowest during the winter when the temperatures and wind speeds are low (Duever, et. al., 1994).

2.7 AIR QUALITY

USEPA and FDEP have established ambient air quality standards for the State of Florida regarding six pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO2), ozone (O3), particulate matter 10 microns or less in diameter (PM10), particulate matter 2.5 microns or less in diameter (PM2.5), and sulfur dioxide (SO2). These adopted standards are shown in Appendix C (Table C-25).

According to the 2001 Air Monitor report prepared by FDEP, air quality parameters measured generally are all well within both National primary, secondary, and Florida Standards on average. Only the eight-hour ozone concentrations exceeded the Florida Standard, but met the National Standard.

2.8 NOISE

Noise in the EAA is not considered a problem because of its rural nature and distances between noise-generating activities. Rural areas have noise levels between 34-55 decibels and may approach 70 decibels along roads and near some agricultural operations. Urban areas are generally about 60 decibels, but may reach 90 decibels or greater in high-activity areas.

2.9 VEGETATION AND COVER TYPES

Within the vegetation and wildlife sections of this report, documentation of resources is segregated by geographic area. Somewhat greater detail is provided for the EAA to allow evaluation of the alternatives. Three other areas affected by this project include: 1) within Lake Okeechobee or the basin; 2) the Northern Estuaries Area (St. Lucie Estuary and Caloosahatchee River Estuary); and, 3) Water Conservation Areas (WCAs).

Common names are used throughout the text, where possible. A list of common vegetation can be found in Appendix C.

2.9.1 Lake Okeechobee

The vegetation and cover types within the Lake Okeechobee region have been greatly altered during the last century. Historically, the natural vegetation was a mix of freshwater marshes, hardwood swamps, cypress swamps, pond apple forests, and pine flatwoods. The freshwater marshes were the predominant cover type throughout, especially along the southern portion of the lake where it flowed into the Everglades. These marshes were vegetated primarily with sawgrass and scattered clumps of Carolina willow, sweetbay, and cypress. Hardwood swamps dominated by red maple, sweetbay, and sweetgum occurred in riverine areas feeding the lake, while cypress swamps were found in depressional areas throughout the region. Pine flatwoods composed of slash pine, cabbage palm, and saw palmetto were prevalent in upland areas especially to the north.

2.9.1.1 Aquatic

The majority of the surface of Lake Okeechobee is not vegetated and provides open water (pelagic) habitat. Open water habitat within Lake Okeechobee covers about 75% of the lake's surface area.

The submergent vegetation of Lake Okeechobee is composed almost entirely of hydrilla (an invasive exotic species), pondweed, bladderwort, and vallisneria. The natant, or floating, component of the littoral zone consists of lotus lily, fragrant water lily, water hyacinth, water lettuce, duckweed, Cuban bulrush, coinwort, and ludwigia.

2.9.1.2 Wetlands

Lake Okeechobee has a diverse and extensive emergent littoral zone that occupies approximately 400 km2 (about 25%) of the lake's surface (Milleson, 1987). Littoral vegetation occurs along much of the lake's perimeter, but is most extensive along the southern and western borders (Milleson, 1987). The littoral zone plant community is composed of a mosaic of emergent, submergent, and natant plant species. A total of 30 distinguishable vegetative community types are documented in a digital cover study (Richardson and Harris, 1995). Emergent vegetation within the littoral zone is dominated by herbaceous species such as cattail, spike rush, and torpedograss (an invasive exotic species). Many of the native aquatic plant species have been adversely impacted, particularly on the north end of the lake due to prolonged high water on the lake over the last couple of years.

2.9.1.3 Exotic Plants

The most recent vegetation mapping of the western Lake Okeechobee littoral zone and marsh, conducted by SFWMD, clearly depicts the dynamic state of vegetative succession within the littoral zone and the spread of less desirable and invasive exotic species into new areas. Results of this vegetation mapping show extensive areas of melaleuca along the rim canal and near shore; spike rush particularly in the Moonshine Bay area; cattail mostly interspersed in smaller stands; hydrilla where large monotypic floating and submergent mats dominate in Fisheating Bay; and, large stands of torpedograss, which largely out compete other species at most water levels.

2.9.2 Northern Estuaries

Seagrasses are undoubtedly among the most important vegetation of the St. Lucie and Caloosahatchee River Estuaries as well as the Indian River Lagoon. Seagrass meadows improve water quality by removing nutrients, dissipating the effects of waves and currents, and by stabilizing bottom habitats thereby reducing suspended solids. Seagrass beds support some of the most abundant and diverse fish populations in the Indian River Lagoon. Seagrass and macroalgae (collectively referred to as submerged aquatic vegetation, or SAV) are highly productive areas and are perhaps the most important habitat of the Indian River Lagoon (IRL CCMP, 1996).

In the St. Lucie Estuary, the predominant species of seagrass is shoalgrass. Shoalgrass often occurs in shallower areas and is commonly used as an indicator species for salinity tolerance ranges and general ecosystem health. Johnson's seagrass, listed as a threatened plant species by the National Oceanic and Atmospheric Administration, may also occur in the vicinity of the St. Lucie Estuary or Indian River Lagoon. In the Indian River Lagoon, turtlegrass occurs in waters generally deeper than 1-2 feet and is often associated with manateegrass.

In the Caloosahatchee River, the primary species of importance is vallisneria. Like the seagrasses of the St. Lucie Estuary and Indian River Lagoon, vallisneria is used extensively as an indicator species for a wide variety of other biota for this area. Vallisneria is a valuable waterfowl food and is considered an excellent plant for fish spawning areas along the river margin. In some areas, vallisneria is declining due to competition with hydrilla and Eurasian watermilfoil, an invasive exotic species (USACE, 1988).

The SAV communities have experienced substantial declines in acreage and quality in recent years. An estimated 30% of the seagrass communities have been destroyed in Florida's estuaries since the 1940s. The Indian River Lagoon

and Charlotte Harbor have each lost about 30% of their seagrass beds. Since 1987, more than 59,000 acres of seagrasses have been affected by several factors including degraded water quality, dredging from boat propellers, freshwater management, severe temperature variability, and others, resulting in a massive die-off (Haddad and Sargent, 1994). The relationship between seagrass growth and sustainability and light transparency has been well documented (Duarte, 1991; Kenworthy and Haunert, 1991; Goldsborough and Kemp, 1988; Stevenson, et al., 1993; Dennison, et al., 1993). Discharges from Lake Okeechobee, with its associated load of suspended and dissolved constituents such as sediments, chlorophyll, and dissolved organic matter, may be impacting the riverine and estuarine seagrass communities and the animals that depend on this habitat.

2.9.3 Everglades Agricultural Area

The diverse South Florida vegetation reflect the influences of the subtropical and south temperate region of North America, as well as the endemic species that have evolved in this unique environment. Currently, much of the native South Florida landscape has been destroyed or substantially reduced by development, hydrologic change, increased nutrients, and the invasion of exotic plants. South of Lake Okeechobee, the historic pond apple swamps and sawgrass marshes have been converted to agriculture. As a result, the only remnants of native plant communities remain in the EAA and even those are highly disturbed.

The types and distribution of vegetation communities within the EAA are based on FWC land cover data for 601,654 acres using 1999 and 2000 Landsat satellite data (Figure 2-2 and Table C-28 in Appendix C). Land cover information was not available for 19,143 acres of the EAA. Habitat types are divided into five general groups: aquatic, wetland, upland, disturbed (mostly agricultural), and urban/extractive. Each of these general habitat types is further separated to provide more detailed information on the nature of the land cover. In all, 24 land cover classes are represented within the EAA. Compartment A contains 15 land cover classes.

2.9.3.1 Aquatic

The aquatic communities within the EAA include both natural and man-made areas of open water such as canals, ditches, and ponds. Open water areas cover 1.7% of the area. The primary canals include Bolles, Cross, Hillsboro, Miami, North New River, and West Palm Beach. The FWC land cover data did not include canals; therefore, no areas of open water habitat are represented in the data total for Compartment A. Based on USACE and SFWMD estimates, Compartment A contains 583 acres of aquatic habitat associated with agricultural canals.

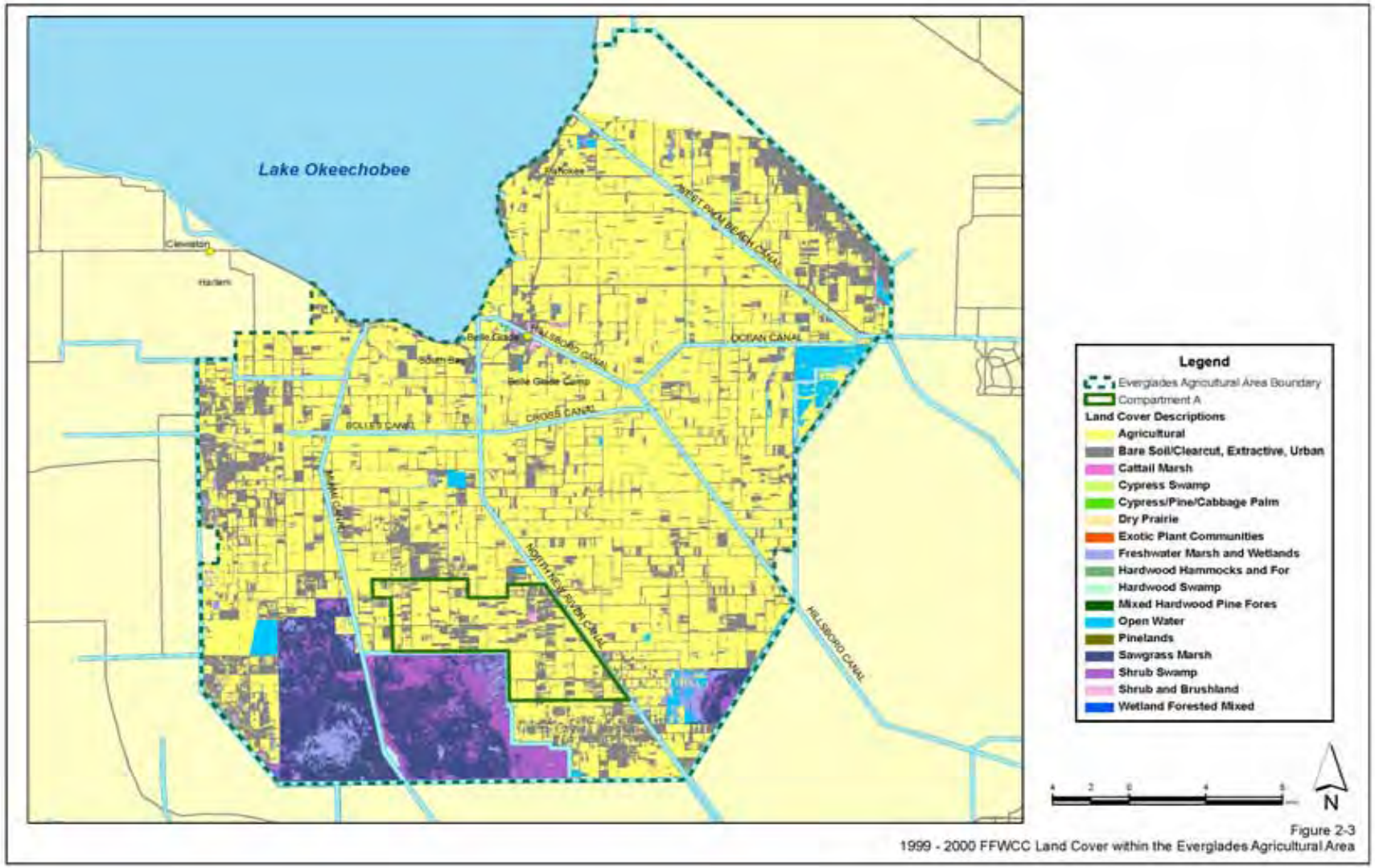

FIGURE 2-2: 1999-2000 FWC LAND COVER WITHIN THE EVERGLADES AGRICULTURAL AREA

2.9.3.2 Wetlands

All of Compartment A of the Talisman Land Exchange property is considered to be atypical jurisdictional wetlands based on hydric soils and hydrology. Wetland vegetation is anticipated to return to the site should agricultural practices cease. Approximately 206 acres on site were characterized by an interagency team as functional wetlands, comprising approximately 0.65 % of the total area. These functional wetlands were described in six categories based on the presence of native or exotic/nuisance vegetation and the percentage of herbaceous or shrub vegetation. Table 2-1 outlines the wetland categories and provides equivalent FWC land cover types as described previously.

TABLE 2-1: RESULTS OF WETLAND EXTENT FIELD SURVEY OF COMPARTMENT A BY INTERAGENCY ECOLOGICAL TEAM.

			Acres of Wetlands (Number of Wetlands)
Category	Description	Example	Compartment A
1	Native Herbaceous Dominated (<20% Shrub)	maidencane, saggitaria, pickelweed	13.07 (1)
2	Native Mixed Herbaceous (20% to 49% Shrub)		0
3	Exotic/Nuisance Shrub (<20% Herbaceous)	primrose willow, Brazilian pepper, baccharis	1.73 (1)
4	Exotic/Nuisance Mixed Shrub (20%-49% Herbaceous)		0
5	Exotic/Nuisance Herbaceous (<20% Shrub)	torpedograss, paragrass and limpo grass	3.45 (1)
6	Exotic/Nuisance Mixed Herbaceous (20%-49% Shrub)		187.63 (2)
Total for all Wetland Categories			205.88 (5)
Source: USFWS, 2003.			

2.9.3.3 Uplands

Upland communities were characterized by using FWC land cover data. Uplands cover 486 acres or 0.08% of the entire EAA. Upland land cover classes include dry prairie, hardwood hammock and forests, pinelands, and mixed hardwood pine forests in descending order of abundance. No upland land cover classes occur within Compartment A.

2.9.3.4 Disturbed Communities

Disturbed communities consist of mostly agricultural lands including pasture (improved and unimproved), row crops, sugarcane, citrus, and other agricultural lands. Included in this general habitat type are two other cover classes: shrub

and brushland, and exotic plant communities. The disturbed habitat types cover 69.5% of the total area with the vast majority of disturbed cover being sugarcane. Within Compartment A, 79% of the area is classified as disturbed with sugarcane also being the dominant cover.

2.9.3.5 Urban and Extractive Communities

The urban and extractive cover communities encompass 14% of the EAA land area and consist of bare soil/clearcut areas (12%), low impact urban land (1%), high impact urban land (less than 1%), and extractive areas (substantially less than 1%). Most of the urban and extractive lands are concentrated around the Belle Glade area. Bare soil/clearcut areas are associated with a recent timber cutting operation, natural bare soils, and bare soil exposed due to clearing vegetation. Low impact urban areas consist of either vegetated or non vegetated lands within areas such as lawns, golf courses, road shoulders, and grassy areas surrounding development. High impact urban areas are non vegetated sites such as buildings, roads, and parking lots. Extractive cover areas consist of surface mining operations such as limestone quarries, phosphate mines, and sand pits as well as the associated industrial complexes.

Within Compartment A, 21% of the land is in the urban and extractive category, with the majority being in the bare soils/clearcut subcategory (20%). The remaining 1% of this category is divided between the low and high urban impact land, with no extractive land designated.

2.9.4 Water Conservation Areas 2 and 3

Almost all of the WCAs are grass-dominated wetlands interspersed with tree islands (hammocks) and willow strands. Tree islands are a unique feature of the Everglades ecosystem. Tropical hardwoods are found on some of the relatively unaltered tree islands in the southern portion of the area.

The basin marsh community type develops in broad, shallow to intermediate depth basins with peat substrate. The dominant plant cover is sawgrass and/or buttonbush and/or mixed emergents. In general, there are three recognizable types of basin wetland communities present in the WCAs:

1. Sawgrass marsh composed of sawgrass with cattail, maidencane, arrowhead, pickerelweed, willow, buttonbush, wax myrtle, and saltbush.
2. Wet prairie, composed of beak rush, spike rush, maidencane, string lily, and white water lily.
3. Aquatic slough composed of white water lily, floating heart, spatterdock, bacopa, and bladderwort.

Forested wetlands in the WCAs include both strands and hydric hammocks. A strand is a broad, shallow channel with peat over a mineral substrate that is seasonally inundated by flowing water. Fire is occasional or rare in this wetland community and dominant vegetation is cypress and/or willow. The following vegetation species are associated with this community: pond cypress, bald cypress, willow, buttonbush, wax myrtle, sawgrass, and royal fern.

A subtropical hydric hammock is a wetland forest community occurring in the WCAs in lowlands over sandy, clay organic soil, often over limestone. Its water regime is mesic to hydric and fire is rare or not a major factor. The following species are associated with this community: sweet bay, red bay, cocoplum, strangler fig, wax myrtle, willow, elderberry, hackberry, cabbage palm, red maple, false nettle, water oak, hornbeam, and needle palm.

Major plant communities in WCA-2A now consist of remnant drowned tree islands, open water sloughs, large expanses of sawgrass, and sawgrass intermixed with dense cattail stands. Remaining tree islands are found primarily at higher ground level elevations, located in the northwest corner of WCA-2A. Remnant (drowned) tree islands, dominated primarily by willow, are found scattered throughout the central and southern sections of WCA-2A. Cattail distribution in WCA-2 reflects 4,400 acres in which cattails represent more than 50% of the vegetation coverage and 24,000 acres of mixed or scattered cattail (<50% coverage) present in the northeast portion of WCA- 2A.

Several studies conducted within WCA-2A show that cattail out-compete sawgrass in their ability to absorb nutrients. There is increased cattail production during years of high nutrient inflows (Toth, 1988; Davis, 1991). Cattail is considered a high nutrient status species that is opportunistic and highly competitive, relative to sawgrass, in nutrient-enriched situations (Toth, 1988; Davis, 1991). Davis (1991) concluded that both sawgrass and cattail increased annual production in response to elevated nutrient concentrations, but that cattail differed in its ability to increase plant production during years of high nutrient supply.

The community structure and species diversity of Everglades vegetation located north of I-75 (WCA-3A North) is very different from the wetland plant communities found south of I-75 (WCA- 3A South). Improvements made to the Miami Canal and impoundment of WCA-3A by levees have over-drained the north end of WCA-3A and shortened its natural hydroperiod. These hydrological changes have increased the frequency of severe peat fires that have resulted in loss of tree islands, aquatic slough, and wet prairie habitat that were once characteristic of the area. Today, northern WCA-3A is largely dominated by sawgrass and lacks the natural structural diversity of plant communities seen in southern WCA-3A.

Over-drainage of the northwestern portion of WCA-3A has allowed the invasion of a number of terrestrial species such as saltbush, dog fennel, and broomsedge. Melaleuca has become well-established in the southeastern corner of WCA-3A North, and is spreading to the north and west.

Vegetation located in the central and southern portion of WCA-3A probably represents some of the best examples of original, undisturbed Everglades habitat left in South Florida. This region of the Everglades appears to have changed little since the 1950s, and contains a mosaic of tree islands, wet prairies, sawgrass stands, and aquatic sloughs similar to those reported by Loveless (1959).

The majority of vegetation within WCA-3A South can be described as typical Everglades habitat with some exceptions due largely to the construction of canals and levees which compartmentalize the WCAs.

2.10 FISH AND WILDLIFE

2.10.1 Lake Okeechobee

The area around Lake Okeechobee includes a wide variety of habitat opportunities for wildlife, including wading and migratory birds, many mammals, amphibians, and reptiles, as well as prey species such as crayfish, prawns, apple snails, and aquatic insects. The USACE conducted a wildlife survey within the western littoral zone of the lake gathering baseline data for key habitat types for reptiles, amphibians, and migratory, and resident birds (USACE, 1999).

Lake Okeechobee is home to a large number of fish species, some of which are valued as commercial and sportfish, and others a key part of the littoral zone food web. The USACE found numerous small fish species, including the Cyprinodontids such as the golden topminnow, the least killifish, and the Florida flagfish which are important food resources for wading birds, amphibians, and reptiles. Over a five year period (1987-1991), mean annual commercial harvest was 2,008 metric tons (Fox, et al., 1992, 1993). Commercially important fish species included white catfish, bluegill, and redear sunfish.

Trawl samples taken by the Florida Game and Fresh water Fish Commission (GFC) from 1987 to 1991 included 25 fish species from the limnetic zone. Threadfin shad were most abundant, and black crappie, most abundant in terms of biomass. These two species, and Florida gar, gizzard shad, white catfish, redear sunfish, and bluegill represented 98% of the total catch in terms of number and weight in the trawl study (Bull, et al., 1995).

Additionally, Furse and Fox (1994) revealed that numerous sportfish occur in the littoral zone. The largemouth bass is one of the most popular gamefish in the State of Florida, and is a major predator of small fish, amphibians, birds, and reptiles. Additionally, the black crappie, bluegill, and redear sunfish are sportfish found in high numbers in the littoral zone.

Macroinvertebrate species found by the USACE include the apple snail, an important food resource of the snail kite, crayfish, grass shrimp, and Dytiscid beetles.

Significant changes have been observed on the lake. Valuable fish habitat including bulrush, spike rush, and SAV has been lost and/or replaced by exotic species such as torpedograss and hydrilla. Reports of muddy, turbid water and drowned vegetation are not uncommon among the public and fisherman. Fishing guides report fish spawning has been poor for the last five years. Others report that shiners (an important bait fish) are becoming increasingly difficult to find and more and more fisherman are forced to the same areas to fish for them. Peppergrass, a floating, leafed aquatic species, important as fish habitat, occurs in deeper water. Once abundant on the lake, it has been severely impacted and is observed mostly in isolated parts of the south end of the lake, notably South Bay. In many people's opinion, these adverse effects are largely due to the sustained high water events persistent on the lake.

A major area of concern to the life cycle of fish and wildlife species is the western littoral zone and marsh, which is representative of similar littoral resources around the lake. The western littoral zone provides tremendous foraging and nesting habitat for a wide range of avifauna. Previous studies (Smith and Collopy, 1995; David, 1994) have documented birds (including state and federally-listed species) such as wood stork, snail kite, great blue heron, white ibis, pied-billed grebe, great egret, snowy egret, little blue heron, tricolor heron, and common moorhen in the area. Other birds that may utilize the littoral zone include the threatened bald eagle, black skimmer, brown pelican, double-crested cormorant, and anhinga.

According to range maps presented by Conant and Collins (1991), reptile and amphibian diversity should be quite high in littoral and marsh areas of the lake. Studied species on Lake Okeechobee include the American alligator and the Florida soft-shelled turtle. Currently, no published inventories are available on the diversity of reptiles and amphibians inhabiting the western littoral zone of Lake Okeechobee.

The USACE found large numbers of the greater siren along with the green water snake and the banded water snake. Additional common species sampled

included frogs such as the southern leopard frog, the green tree frog, and the squirrel tree frog.

Several reports from local residents have confirmed sightings of non-native species of lizards, such as the green iguana, the spiny-tailed iguana, and the brown basilisk. Established populations of such species could be extremely harmful to native reptile and amphibian populations.

Lake Okeechobee also provides major resources for mammals. The Okeechobee Waterway, a designated channel that runs around the perimeter of the lake, as well as across the lake, provides habitat for the endangered West Indian manatee. Additionally, river otters, bobcats, and the Florida water rat, a species of special concern as listed by the Florida Committee for Rare and Endangered Plants and Animals, have been observed within the lake.

2.10.2 Northern Estuaries

The Northern Estuaries refer to the St. Lucie Estuary on the east coast of Florida, which flows into another estuary, the southern end of the Indian River Lagoon, and the Caloosahatchee Estuary on the west coast of Florida. The Indian River Lagoon system is a biogeographic transition zone, rich in habitats and species, with the highest species diversity of any estuary in North America (Gilmore, 1977). Approximately 4,315 different plant and animal species have been identified in the lagoon system. Included are 2,965 species of animals, 1,350 species of plants, 700 species of fish and 310 species of birds (IRL CCMP, 1996). Species diversity is generally high near inlets and toward the south, and low near cities, where nutrient input, freshwater input, sedimentation, and turbidity are high and where large areas of mangroves and seagrasses have been lost. For biological communities and fisheries, seagrass and mangrove habitats are extremely important (Virnstein and Campbell, 1987). Much of the habitat loss has occurred as a result of the direct effects of shoreline development, navigational improvements, and marsh management practices.

Most of the predominant freshwater fishes recorded from the lagoon system, such as minnows, bullhead catfishes, and sunfishes are found mainly or exclusively in the tributary streams including the streams feeding the St. Lucie. Examples of other species in this habitat include all of the ubiquitous forms mentioned above as well as Florida gar; gizzard shad; flagfish; bluefin killifish; mosquitofish; least killifish; sailfin molly; inland silverside; gulf pipefish; leatherjack gray snapper; Irish pompano; silver jenny; fat sleeper; bigmouth sleeper; and, lined sole. Fish species that specialize in creek-mouth habitats include: yellowfin menhaden, gafftopsail catfish, timucu, needlefish, gulf killifish, striped killifish, mosquitofish, sailfin molly, lined seahorse, chain pipefish, gulf pipefish, tarpon snook, Atlantic bumper, gray snapper, Irish

pompano, silver jenny, great barracuda, gobies, sleepers, puffers, filefish, and, many others.

In addition to finfish, the estuaries and Indian River Lagoon support a variety of shellfish. Blue crabs, stone crabs, hard clams, and oysters are important estuarine commercial species. The blue crab accounted for approximately 80% of shellfish landings in the Indian River Lagoon between 1958 and 1988 (IRL CCMP, 1996). Oysters are an important indicator organism and are known to be sensitive to salinity changes in their environment.

The Caloosahatchee River Estuary starts at the Franklin Lock and continues downstream nearly 30 miles to San Carlos Bay. Although various changes have historically occurred in the Caloosahatchee Estuary (channelization, shoreline hardening, point, and non-point source impacts), the estuary sustains numerous and diverse fish and wildlife populations. Important resources within the estuarine portions of the Caloosahatchee are SAV including seagrass, oyster bars, open bottom community, and mangrove-lined shorelines. These communities provide important habitat supporting many wildlife species.

Manatees, waterfowl, and wading birds rely on seagrass communities as foraging area. SAV are an integral nursery area for commercially and recreationally important fish and shellfish. Seagrass communities provide critical refugia for juvenile fish such as redfish, grouper, snook, and spotted seatrout. In addition, the upper and middle portions of the Caloosahatchee River support a blue crab fishery. Oyster bars and open bottoms of sand mud, shell, and bedrock provide important habitat and food for other estuarine species. They harbor a rich macro invertebrate community that is utilized by wading and shorebirds and fish.

In the Caloosahatchee Estuary, mangroves support fish and macro invertebrate communities by providing a protected nursery area. Important marine and estuarine species that spend part of their life cycle in the mangrove community include snook, snapper, tarpon, jack, sheepshead, red drum, ladyfish, blue crab, and shrimp. Mangroves forests also provide important foraging and nesting habitat for diverse populations of birds.

2.10.3 Everglades Agricultural Area

Altered native habitats dominate the EAA; however, remaining wetlands offer some native habitat for fish and wildlife species. Although there are few published fish and wildlife studies available for the area, lists of potentially occurring and confirmed species have been compiled from a variety of sources including: the FWC 1987-1993 Wildlife Observation Database, the FNAI Element Occurrence Database (through 2002), the FWC Breeding Bird Atlas,

and the FWC Wading Bird Rookery data. For additional information on fish and wildlife resources in EAA, see the FWCA Report in Annex A, including wildlife observations documented for Compartment A as part of field surveys of wetlands.

General wildlife use of the area can be derived from information about the present vegetation communities. The following sub-sections briefly discuss typical wildlife use based on FWC land cover data of habitat types.

2.10.3.1 Aquatic

The distinction between wetland and aquatic habitat is sometimes not apparent; however, aquatic habitat typically represents deeper, permanent water bodies with little or no emergent vegetation. Similarly, aquatic fauna often move between deeper water areas and wetlands depending upon habitat requirements. Fish are the most common vertebrate found in aquatic habitats. Typical species include largemouth bass, bowfin, Florida gar, and sunfish. Mammals that are typically in aquatic habitat include the West Indian manatee and river otter. Manatees are found in canals that interconnect with coastal water bodies, whereas river otter may be found in all aquatic habitats as they are capable of traversing some distance over land to reach water bodies where they feed. Birds using aquatic habitats include ducks, wading birds (great blue heron, great egret), aquatic birds (terns, cormorant, anhinga), and osprey. The most conspicuous reptile observed in open water areas is the American alligator.

2.10.3.2 Wetlands

Herbaceous wetlands (sawgrass marsh, freshwater marsh, wet prairie) provide habitat for a variety of birds due to the diversity of vegetation in adjacent habitats. Examples of some of the many types of birds include: songbirds (common yellowthroat, red-winged blackbird, boat-tailed grackle); marsh and wading birds (least bittern, king rail, sora, green-backed heron, great blue heron, great egret, limpkin); ducks and aquatic birds (American coot, common moorhen, anhinga); and, birds of prey (osprey, red-shouldered hawk, Everglades kite). Mammals that utilize these habitats include river otter, marsh rabbit, and raccoon. Fish typical of these areas include mosquitofish, Florida gar, and bluefin killifish. Reptiles and amphibians common to herbaceous wetlands include: American alligator, water moccasin, water snake, Florida cooter, southern leopard frog, and green tree frog.

Forested and shrub swamp fauna are home to a variety of mammals such as white-tailed deer, marsh rabbit, Florida panther, cotton mouse, raccoon, fox squirrel, and Florida black bear. These woody swamps are habitat for birds such as barred owl, pileated woodpecker, red-bellied woodpecker, white-eyed vireo, yellow-rumped warbler, and red-shouldered hawk. Reptiles and amphibians

such as the rough green snake, eastern indigo, water moccasin, and southern toad are often found in these areas.

2.10.3.3 Uplands

Upland communities consist of relatively open, herbaceous habitat such as dry prairie to forested communities of varying vegetation composition such as hardwood hammocks, pinelands, and a mixture of hardwoods and pine. Dry prairies provide habitat for raccoon as well as the wide-ranging Florida panther. Birds typical of this open habitat include common ground dove, eastern meadowlark, and crested caracara.

2.10.3.4 Disturbed and Urban/Extractive Communities

Wildlife species that may be found in agricultural, urban or mining lands are typically tolerant of open conditions, a certain amount of human activity, and are not restricted to specialized habitats. Species found in these habitats include: raccoon, boat-tailed grackle, bobwhite, cattle egret, black vulture, turkey vulture, crested caracara, eastern meadowlark, northern mockingbird, red-winged blackbird, white ibis, box turtle, and green anole. Some species that require open habitat, such as burrowing owls, may make use of this habitat in addition to dry prairie.

2.10.4 Water Conservation Areas

The WCAs as a whole contain a number of important species whose existence, population numbers, and sustainability are markedly influenced by water levels. The American alligator, a keystone Everglades species, has rebounded in terms of population numbers since the 1960s when the reptile was placed on the endangered species list by the USFWS. Alligators, it is believed, play an important ecological function by maintaining "gator holes", or depressions, in the muck which are thought to provide refuge for aquatic organisms during times of drought and concentrates food sources for wading birds. High water during periods of nest construction, which occurs from June to early July (Woodward, et al., 1989), decreases the availability of nesting sites. If conditions become too dry, either naturally or through water management practices, water levels may fall too low to maintain gator holes, forcing the animal to seek other areas to survive.

Other important reptile species commonly encountered within the Study Area include a number of species of turtles, lizards, and snakes. Turtle species include the snapping turtle, striped mud turtle, mud turtle, cooter, Florida chicken turtle, and Florida softshell turtle. Lizards such as the green anole are found in the central Everglades, and several species of skinks occur more commonly in terrestrial habitats. Numerous snakes inhabit the wetland and

terrestrial environments. Drier habitats support such species as the Florida brown snake, southern ringneck snake, southern black racer, scarlet snake, and two rattlesnake species. The eastern indigo snake, a Federally listed threatened species, and the Florida pine snake, a state species of special concern, may also exist in drier areas of the Study Area. Wetter habitats support more aquatic species such as the water snake, the green water snake, mud snake, eastern garter snake, ribbon snake, rat snake, and the Florida cottonmouth (McDiarmid and Pritchard, 1978).

Important amphibians known to occur in South Florida include the Everglades bullfrog, or pig frog, Florida cricket frog, southern leopard frog, southern chorus frog, and various tree frogs common to tree islands and cypress forests. Salamanders inhabit the densely vegetated, still or slow-moving waters of the sawgrass marshes and wet prairies. They include the greater siren and the Everglades dwarf siren. Toads such as the eastern narrow-mouth toad also occur within the Study Area.

Colonial wading birds are a conspicuous component of the wildlife communities that utilize the WCAs as both feeding and breeding habitat. These include 11 species of herons and egrets, two species of ibis, the wood stork, and the roseate spoonbill (Robertson and Kushlan, 1984). Historically, white ibis has been the most abundant colonial wading bird species within the WCAs. Surveys indicate that the great egret is the second most abundant species (Frederick and Collopy, 1988). The great blue heron, little blue heron, tricolored heron, green-backed heron, snowy egret, cattle egret, black-crowned night heron, and yellow-crowned night heron, are also common wading bird species found throughout the WCAs. The roseate spoonbill, a state listed species of special concern, and the wood storks, a Federally listed endangered species, both occur within the WCAs. The WCAs support additional aquatic avifauna, such as the limpkin, two species of bitterns, the anhinga, as well as a number of resident and migratory waterfowl.

Aerial surveys indicate that white ibis, great egrets, great blue herons, wood storks, little blue herons, snowy egrets, cattle egrets, and glossy ibis are the most common wading bird species utilizing the WCAs, with populations varying widely in relationship to seasonal water level fluctuations. Peak wading bird use of the WCAs often occurs in January in synchrony with receding water levels, with over 121,000 birds being observed at times. Lowest counts have occurred during August with less than 15,000 birds counted. The white ibis is typically the most abundant wading bird observed, with total monthly counts varying as the birds move in and out of the WCAs in response to changing water levels. Great egrets represented the second most abundant species of wading birds observed.

The Everglades fish community is composed of a variety of forage fish important in the diet of many wading birds, sport fish, native species, and exotics introduced partly through aquacultural practices and the aquarium trade. Forage species include the Florida flagfish, bluefin killifish, least killifish, shiners, mosquito fish, and sailfin molly.

Generally, Everglades sportfish are harvested from the borrow canals that surround the marsh. As water levels in the canal and marsh rise, fish populations disperse into the interior marsh and reproduce with minimum competition and predation. As water levels recede, fish concentrate into the deeper waters of the surrounding canals, where they become available as prey for wildlife and fishermen. In some instances, the canal fishery has experienced major fish kills due to overcrowding and oxygen depletion. The WCAs provide a valuable sport fishery for South Florida. Many of the canals, notably along U.S. 41, I-75, and in the L-35B and L-67A, provide valuable recreational fishing for largemouth bass, sunfish, oscar, gar, bowfin, catfish and other species.

Besides supporting a valuable recreational fishery for the region, WCA fish communities provide a major food source for Everglade wading birds, alligators, and other carnivorous reptiles and mammals. Fish community structure and abundance is highly dependent on water levels. Consequently, fishing success by humans or wildlife is also dependent on water levels (Dineen, 1974). For a more complete listing of common Everglades fishes, reference Gunderson and Loftus (1993).

Several game and non-game wildlife species occur within the WCA system including: white-tailed deer, common snipe, and marsh rabbit. Blue-winged teal, mottled ducks, and other game waterfowl are found in the sloughs of the northeast corner. Feral hogs may also be present in drier areas or on tree islands.

2.10.5 Canals

Approximately 23 miles along the North New River, 7 miles along the Bolles, and 8.5 miles along the Cross Canal are proposed for expansion as part of the EAA Reservoir project. The expansion zones are located within the EAA and are expected to be similar. Fish species common to these canals include largemouth bass, black crappie, redear sunfish, brown bullhead, least killfish, bluegill, and mosquitofish.

2.11 THREATENED AND ENDANGERED SPECIES

Per the agreement between the USACE and U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NOAA), the Draft PIR/EIS also serves as the Biological Assessment for the purpose of Section 7 consultation

under the Endangered Species Act. Table 2-2 contains a compilation of listed species potentially occurring within the EAA or other affected areas. This sub-section will state the federally-listed species that occur in each of the geographic regions affected by this project; following that will be a description of the listed species.

TABLE 2-2: LIST OF PROTECTED SPECIES IN THE AFFECTED AREA

Group	Scientific Name	Common Name	Listed Status
Mammals	*Felis concolor coryi*	Florida panther	FE, SE
	Trichechus manatus latirostris	West Indian manatee	FE, SE
Birds	*Ajaia ajaja*	Roseate spoonbill	SSSC
	Aramus guarauna	Limpkin	SSSC
	Caracara plancus audubonii	Crested caracara	FT, ST
	Egretta caerulea	Little blue heron	SSSC
	Egretta thula	Snowy Egret	SSCC
	Egretta tricolor	Tricolored heron	SSCC
	Eudocimus albus	White ibis	SSCC
	Flaco peregrinus	Peregrine falcon	SE
	Falco sparverius paulus	South American kestrel	ST
	Grus canadensis pratensis	Florida sandhill crane	ST
	Haliaeetus leucocephalus	Bald eagle	FT, ST
	Mycteria americana	Wood stork	FE, SE
	Rostrhamus sociabilis plumbeus	Everglades snail kite	FE, SE
	Rynchops niger	Black skimmer	SSSC
	Speotyto cunicularia floridana	Florida burrowing owl	SSCC
	Sterna antillarum	Least tern	ST
Reptiles	*Alligator mississippiensis*	American alligator	FT (S/A), SSC
and	*Caretta caretta*	Loggerhead sea turtle	FT, ST
Amphibians	*Chelonia mydas*	Green sea turtle	FT, SE
	Drymarchon coaris couperi	Eastern indigo snake	FT, ST
	Dermochelys coriacea	Leatherback sea turtle	FE, SE
	Eretmochelys imbricata imbricata	Hawksbill sea turtle	FE, SE
	Gopherus polyphemus	Gopher tortoise	SSSC
	Lepidochelys kempii	Kemp's ridley sea turtle	FE, SE
Fishes	*Microphis brachyurus lineatus*	Opossum pipefish	FSSC
	Pristis pectinata	Smalltooth sawfish	FE, SE
Plants	*Cucurbita okeechobeensis*	Okeechobee gourd	FE, SE
	Halophila johnsonii	Johnson's seagrass	FT

Listed Status Key: F=Federal; S=State; E=Endangered;
T= Threatened; SSC=Species of Special Concern;
S/A=Similarity of Appearance

2.11.1 Lake Okeechobee

Even with habitat fragmentation and degraded ecological communities, Lake Okeechobee provides habitat for a diversity of wildlife including federally and state listed plants and wildlife. Species covered in this sub-section include only those species occurring within or using the lake's open water habitat, SAV, or fringing littoral marshes, rather than the entire watershed.

The lake and its associated wetlands provide habitat for federally protected species including the bald eagle, wood stork, snail kite, West Indian manatee, American alligator, and the Okeechobee gourd. Bald eagle nests are found along or near Lake Okeechobee. The wood stork uses a variety of wetlands to forage for small invertebrates that are found concentrated in receding water levels. Snail kites prey exclusively on apple snails that have been historically abundant in and around the Lake Okeechobee and its marshes. Portions of the lake and surrounding areas are designated as critical habitat. The West Indian manatee can access the lake from either the east or west through either the Caloosahatchee River or the St. Lucie Canal. The Okeechobee gourd occurs in shrubby locations along the southern shore of the lake.

2.11.2 Northern Estuaries

Many of the protected species known from the EAA or Lake Okeechobee also occur in the northern estuaries. These include various wading birds (including the federally endangered wood stork), American alligator, West Indian manatee, and bald eagle. Manatees are an opportunistic herbivore that feed on a wide variety of plants including vallisneria, an important food resource in the Caloosahatchee Estuary. They are also known from the St. Lucie Estuary and venture up river through the locks of the St. Lucie Canal.

Species that occur occasionally in both estuaries include five species of sea turtles, two species of fish, and Johnson's seagrass. The turtle species are protected under both state and federal law and include the Atlantic loggerhead, Atlantic green turtle, leatherback turtle, Atlantic hawksbill, and Kemp's ridley turtle. The two protected fish species that occur are the opossum pipefish and smalltooth sawfish.

2.11.3 Everglades Agricultural Area

Although the EAA is predominantly agricultural land, with remnant pockets of natural wetlands and a network of canals, it provides habitat for the following federally-listed species: Florida panther, West Indian manatee, wood stork, bald eagle, American alligator, and Eastern indigo snake. Although Audubon's crested caracaras have not been documented within the EAA Project footprint, individuals may pass through, forage, or even nest in the area periodically.

2.11.4 Water Conservation Areas

Federally protected species occurring both in the EAA and WCAs include many of the protected species in the South Florida region including the American alligator, bald eagle, wood stork, Audubon's crested caracara, Everglades snail kite, Florida panther, and possibly the Eastern indigo snake. The WCAs also have designated critical habitat for the Everglades snail kite in WCA-2 and WCA-3A.

2.11.5 Species Descriptions

2.11.5.1 Florida Panther

The endangered Florida panther [Felis (Puma) concolor coryi] is one of the most endangered large mammals in the world, being the only extant breeding puma population east of the Mississippi River and presently only found in Florida. The panther prefers native upland forests to the wetlands and disturbed habitats types found in Compartment A (USFWS 1999). Although the core population is currently located southwest of the EAA project footprint, panthers range throughout central and southern Florida. Existing data was searched to document panther use of the habitat or movement through the region. The Florida panther was monitored from February 1981 to June 2001 using radio telemetry from aircraft by the FWC, ENP, and Big Cypress National Preserve. The data, maintained by the FWC, was searched and documented for panther occurrences within the EAA. In addition, panther road kill data was searched; however, no road kills occurred within the EAA, with the closest road kill located two miles west of the EAA boundary.

The EAA is included in the panther's habitat range and three Florida panthers (numbers 26, 43 and 90) have been documented in the EAA. Secondary zone for the panther is located adjacent to the EAA area. No occurrences within Compartment A have been documented.

2.11.5.2 West Indian Manatee

The endangered West Indian manatee (Trichechus manatus) is a large, aquatic mammal that migrates along the Florida coast through fresh, brackish, and marine waters, and exhibits a seasonal distribution based on water temperatures. Waters colder than 20 degrees Celsius increase the manatee's susceptibility to cold-stress and cold-induced mortality. Distribution is also controlled by aquatic vegetation availability, proximity to water channels of at least 2 meters in depth, and location of fresh water sources (USFWS, 1999). Manatees are currently able to access canals within the EAA including those associated with Compartment A and the three canals slated for expansion.

Manatees are also found in other inland fresh waters that may be affected by the EAA Project, such as Lake Okeechobee, SLE, and CE. This slow-moving aquatic mammal is an opportunistic herbivore feeding on a variety of submergent, emergent, or floating aquatic vegetation including bank grasses and overhanging plants. A study is currently underway to document the use of canals by the manatee (Ferrell, D. [personal communication] USFWS, 2004). Watercraft collisions, water control structures, and navigational locks are principal hazards to manatees.

A survey of manatee accessibility performed by the CERP Interagency Manatee Task Force (Manatee Task Force), consisting of representatives from the USFWS, FWC, USACE, SFWMD, U.S. Geological Survey (USGS), National Park Service, and the Miami-Dade Department of Environmental Resources Management, shows that manatees access canals within the EAA by navigating from the Okeechobee Waterway through the gates at structures S-351, S-352, or S-354. A manatee habitat suitability survey was also performed in 178 miles of canals within the EAA. The survey was conducted using the following criteria: canal configuration, forage availability, refugia, temperature, presence of structures, mortality/rescue incidents, boat ramps, watercraft, and structure accessibility. The Manatee Task Force concluded the risks of manatee entrapment/mortality in the EAA canals outweigh the availability of suitable manatee habitat (CERP Interagency Manatee Task Force, 2004).

2.11.5.3 Wood Stork

The endangered wood stork (Mycteria americana) is a long-legged wading bird that typically forages in freshwater marshes, ponds, ditches, tidal creeks and pools, impoundments, pine/cypress depressions, and swamp sloughs (USFWS, 1999). The wood stork has been documented in EAA wetlands, temporarily flooded fields, and in associated canals and ditches. In addition, wood stork nesting colonies are within foraging range of the project footprint and occur adjacent to Lake Okeechobee and downstream in the EPA. Wood storks may also forage within the SLE and CE areas.

Wood storks are large, long-legged wading birds. They have a heavy bill that is used to locate prey items, mostly fish and crustaceans, by touch in shallow water. Prey must be concentrated in high densities to forage effectively; therefore, wood storks frequent drying wetland pools. Nesting occurs in trees-typically cypress-and communal nest sites occur or have occurred in all South Florida counties.

2.11.5.4 Bald Eagle

Although the threatened bald eagle (Haliaeetus leucocephalus) has been proposed for delisting under the ESA (64 FR 36453), it is still protected under

the ESA, the Bald and Golden Eagle Protection Act (16 U.S.C. § 668 et seq.), and Migratory Bird Treaty Act (16 U.S.C. § 703 et seq.). Bald eagles are the largest raptor in the eastern United States and are known to breed throughout Florida. Nest sites are usually located near large rivers, lakes, or estuaries where they feed primarily on fish and water-dependent birds. Bald eagle distribution is influenced by the availability of suitable nest and perch sites near large open water bodies, typically with high amounts of water-to-land edge (USFWS, 1999).

Bald eagle nests have been documented within the EAA, around Lake Okeechobee, and in conjunction with the SLE and CE. No known active or inactive nest sites are located adjacent to the EAA Project footprint. The FWC Bald Eagle Nest Locator Database was checked for the presence of eagle nests. This data uses annual aircraft surveys to develop their information. Five eagle nests are located in the Palm Beach County portion of the EAA.

2.11.5.5 Audubon's Crested Caracara

The threatened Audubon's crested caracara (Polyborus plancus audubonii) is a large raptor that was once a common resident from northern Brevard County south to Hendry County, although sporadic sightings throughout peninsular Florida have occurred. The caracara is listed as threatened by the federal government and by the State of Florida. The greatest abundance of breeding and nesting activities is in a five county area north and west of Lake Okeechobee (Glades, Desoto, Highlands, Okeechobee and Osceola Counties). This species generally favors dry or wet prairies with scattered cabbage palms. The caracara also now uses improved or semi-improved pasture with seasonal wetlands as habitat. They prefer to nest in cabbage palms surrounded by low ground cover. Caracaras are opportunistic feeders eating carrion or live prey. Prey items include small mammals (rabbits, opossums, rats, mice squirrels), frogs, lizards, fish, young birds, and insects (USFWS, 1999). Average home range is 1,552 HA, although juvenile caracaras are nomadic and numerous sightings occur outside the five-county core area.

Within the EAA, sparse sightings of the caracara are noted. One observation of a caracara was documented by the FNAI along L-3 in 1978. Another observation was made by the USFWS; however, the location within the EAA was noted only as a roadside survey. There are no known nest sites located on or in close proximity to the EAA project footprint.

2.11.5.6 Everglade Snail Kite

The endangered Everglade snail kite (Rostrhamus sociabilis plumbeus) is a medium sized raptor and food specialist that feeds almost entirely on apple snails (Pomacea paludosa) which are found in palustrine emergent, long hydroperiod wetlands (USFWS, 1999). It is restricted to clear, calm waters of

freshwater marshes and edges of lakes in South and Central Florida including Palm Beach and Hendry Counties. Nearly continuous flooding is required to sustain apple snail populations. Snail kites require small trees or shrubs near foraging areas as nest sites. Appropriate habitat for apple snails and snail kites is not expected within the current wetlands in Compartment A and associated canals and are not expected within the project reservoir, seepage/habitat buffer, or littoral shelves along the seepage canal (USFWS, 2005).

Designated critical habitat for the snail kite exists on the western side of Lake Okeechobee and portions of the EPA downstream, including WCA 2 and 3A. They were also sighted in the Holey Land WMA. Wood storks and snail kites have overlapping ranges, but different feeding mechanisms and require different hydrologic conditions for optimum feeding. Historically, both have survived with the hydrologic variability characteristic of the natural system. The reduced heterogeneity and extent of natural area of the present system make the snail kites more vulnerable to natural and human-caused threats (USFWS, 1999). The critical habitat on Lake Okeechobee tends to have suitable habitat even during wet and dry years, whereas water stages in WCA-3A fluctuate greatly during wet and dry years.

2.11.5.7 Eastern Indigo Snake

The historical range of the threatened eastern indigo snake (Drymarchon corais couperi) was throughout Florida, and the coastal plain of Georgia, Alabama, and Mississippi. Today, it is present only in Georgia and throughout Florida, but its abundance is reduced to a point where it is uncommon. Habitat for the indigo snake includes pine flatwoods, scrubby flatwoods, high pine, dry prairie, tropical hardwood hammock, edges of freshwater marshes, agricultural fields, coastal dunes, and human-altered habitats (USFWS, 1999). The snake inhabits primarily drier areas including agricultural fields and the margins of freshwater marshes, and may be present within Compartment A and along the canals slated for expansion. The snake is also present within the EPA and in areas surrounding Lake Okeechobee.

The milder climate of Central and South Florida may not require indigo snakes to have underground thermal refugia as they do farther north; yet they frequently use natural holes, gopher tortoise burrows, trash piles and the like even in warmer South Florida. They use a variety of food sources including fish, frogs, toads, lizards, turtles and their eggs, small alligators, birds and small mammals (USFWS, 1999).

The eastern indigo snake is not documented by the FWC or FNAI to be specifically in the EAA, but it likely is found in the uplands and margins of

wetlands or agricultural areas. They typically range over large areas with adult males traveling as much as 158 HA to 224 HA in the summer.

2.11.5.8 American Alligator

The American alligator (Alligator mississippiensis) is a common inhabitant of freshwater and estuarine lakes, ponds, sloughs, swamps, and canals throughout South Florida. It is protected as a threatened species by the federal government due to its similarity of appearance to other endangered crocodilian species. The American alligator is commonly found in aquatic habitats within the EAA. This project is not likely to have an effect on the alligator, and as such, will not be addressed any further in alternatives analysis.

2.11.5.9 Sea Turtles

The endangered leatherback sea turtle (Dermochelys coriacea) is the largest of the sea turtles. The leatherback turtle regularly nests on the east coast of Florida, with the nesting and hatching season lasting from mid-February to mid-November. The adults are highly migratory and spend the most time in the pelagic zone compared to the other sea turtles. They have been found to exhibit broad thermal tolerances (NMFS & USFWS, 1995). Nesting females prefer high-energy beaches with deep, unobstructed access. Based on surveys of nests in South Florida, they nest mainly in Palm Beach County, and secondly Martin County. Leatherback turtles appear to feed primarily on jellyfish. The status of leatherback populations in the U.S. is not known; intensive studies of nesting leatherback turtles have occurred at Sandy Point National Wildlife Refuge in U.S. Virgin Islands (USFWS, 1999).

The endangered hawksbill sea turtle (Eretmochelys imbricata imbricata) is commonly found in the Caribbean Sea and waters on either side of Florida. In particular, they are regularly seen in the waters of the Florida Keys and reefs off Palm Beach County. In contrast to the green and loggerhead sea turtles, the hawksbill sea turtle nests in low densities on South Florida beaches, with aggregations typically in the range of a few dozen individuals. Hawksbill turtles inhabit the pelagic zone in their early years, then come closer to shore near coral reefs, but may also inhabit mangrove-fringed bays and estuaries. In the near-shore habitat, they primarily feed on sponges (USFWS, 1999).

The endangered Kemp's ridley sea turtle (Lepidochelys kempii) is the smallest and most endangered (in the western hemisphere) of the sea turtles, and is extremely rare in Florida. Juvenile turtles may be found along the eastern seaboard and in the Gulf of Mexico. Nesting in Florida is very rare, with only five reported occurrences. Kemp's ridley turtles are mostly carnivorous, eating mainly crabs and other shallow, benthic organisms. The current estimate of nesting females, based on nest surveys and various factors for clutch size and

average number of nests, ranges between 509-740 females (NMFS & USFWS, 1995; USFWS, 1999).

The threatened green sea turtle (Chelonia mydas) nests regularly in South Florida where the nesting and hatching season lasts from May to November. Important feeding areas for the green sea turtle include Indian River Lagoon, Florida Keys, Florida Bay, Homosassa River, Crystal River, and Cedar Key. Green sea turtles occupy three habitat types: high-energy oceanic beaches, convergence zones in the open ocean, and benthic feeding grounds in shallow, protected waters. A survey of green sea turtle nests conducted from 1985 to 1995 showed that Palm Beach County has the second highest percentage of green sea turtle nests in Florida (USFWS, 1999). Green sea turtles are primarily herbivorous, eating seagrasses and algae in the benthic feeding grounds. While in the pelagic zone, they may also eat shellfish, jellyfish, and other organisms (NMFS & USFWS, 1995).

The threatened loggerhead sea turtle (Caretta caretta) is the most common sea turtle in South Florida. The geographic range of its habitat is temperate and tropical waters worldwide. Within Florida, 80% of the nesting occurs on the east coast of Florida, especially from Brevard through Broward Counties. The nesting and hatching season runs from mid-March to November. Nesting females prefer moderate to high-energy beaches with steep slopes. Loggerhead turtles inhabit a variety of habitats, from turbid, muddy-bottom bays along the northern Gulf of Mexico coast, to clear, sandy-bottom reefs and shoals of the Caribbean. Upon hatching, juveniles swim out to Sargassum areas in the pelagic zone, and stay there until they reach sub-adulthood. At that point, they migrate to nearshore and estuarine waters. Loggerhead turtles primarily eat benthic invertebrates, such as snails, bivalve mollusks (e.g., clams), and crabs (USFWS, 1999). Loggerhead monitoring suggests that population levels in Florida have remained stable (NMFS & USFWS, 1995).

Environmental threats to sea turtles in the marine environment include: gas and oil drilling; loss of seagrass habitat; development; pollution; fishing-related activities; underwater explosions; dredging; boat collisions; entanglement; ingestion of debris; and poaching. Nesting-related threats include: artificial lights; beach nourishment activities; human presence; poaching; recreational equipment; and habitat loss (USFWS, 1999).

2.11.5.10 Smalltooth Sawfish

The endangered small-toothed sawfish (Pristis pectinata) is one of two species of sawfish that inhabit U.S. waters. Smalltooth sawfish commonly reach 5.5 meters in length, and may grow to 7 meters. Little is known about the life history of these animals, but they may live up to 25-30 years and mature after

about 10 years. Like many elasmobranches (e.g., sharks), smalltooth sawfish are ovoviviparous, meaning the mother holds the eggs inside of her until the young are ready to be born; although there are no studies on actual litter size, its similarity in size and habitat to the largetooth sawfish suggests litter size may be in the range of 1-13 individuals. Sawfish species inhabit shallow coastal waters of tropical seas and estuaries throughout the world. They are usually found in shallow waters very close to shore over muddy and sandy bottoms. They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths. Sawfish are among the few elasmobranchs that are known from freshwater systems in many parts of the world (NMFS, 2000).

Smalltooth sawfish have been reported in both the Pacific and Atlantic Oceans, but the U.S. population is found only in the Atlantic. Historically, the U.S. population was common throughout the Gulf of Mexico from Texas to Florida, and along the east coast from Florida to Cape Hatteras; historical records also indicate the smalltooth sawfish were found in the lower reaches of the St. Johns River and Indian River lagoon. The current range of this species has contracted to peninsular Florida, and smalltooth sawfish are relatively common only in the Everglades and Florida Keys; the presence of this species appears to have been abolished from Indian River lagoon. No accurate estimates of abundance trends over time are available for this species. However, available records, including museum records and anecdotal fisher observations, sawfish have declined dramatically in U.S. waters over the last century (NMFS, 2000).

Smalltooth sawfish generally eat whatever small schooling fish may be abundant locally, such as mullet. They may also feed on crustaceans and other benthic organisms. The sawfish has been seen as "stirring the mud with its saw" to locate its prey, or attacking schools of small fish by slashing sideways with its saw and eating the wounded fish (NMFS, 2000).

2.11.5.11 Opossum Pipefish

The opossum pipefish (Microphis brachyurus lineatus), a species of special concern and candidate species, is a circumtropical species and is mainly found in southeast Florida and the Rio Grande River, Texas. In southeast Florida, the opossum pipefish typically inhabits dense emergent bank vegetation usually dominated by Panicum spp. and Polygonum spp. (Gilmore and Gilbert 1992). The species has consistently been collected only from the Loxahatchee River drainage, St. Lucie River, Sebastian Creek, the St. Lucie Canal at Lake Okeechobee (Gilmore and Hastings 1983), and in relief canals associated with tributaries. It is able to negotiate its way through canal locks, as evidenced by its occurrence in Lake Okeechobee (Gilmore and Gilbert 1992). The opossum pipefish matures, mates, and releases its progeny in fresh water in dense emergent bank vegetation. Egg brooding is performed exclusively by the males,

with the number of eggs carried being a function of the size of the individual (Gilmore and Gilbert 1992). Newly released larvae must have brackish oligohaline-mesohaline conditions (18 ppt salinity) to survive, and are adapted for downstream transport to estuarine and marine environments during the wet season (Frias-Torres, 2002). Juveniles subsequently move offshore, where they become associated with pelagic rafts of floating vegetation, in which they remain for an indeterminate length of time. Opossum pipefish are carnivorous, preying on crustaceans and small fish as ambush predators in dense vegetation.

Major threats to the opossum pipefish are habitat destruction, declining water quality, and an increase in disease. Vegetation elimination destroys adult pipefish breeding and feeding habitat.

2.11.5.12 Okeechobee Gourd

The Okeechobee gourd (Cucurbita okeechobeensis) is the only federally-listed plant species occurring in the vicinity of the EAA. This endangered plant once grew extensively in the pond apple swamps south of Lake Okeechobee; however, conversion of these habitats for agriculture has eliminated most (95%) of the natural habitat. The vine is restricted to eleven sites along the southern shore of Lake Okeechobee in Palm Beach County and nine sites in Volusia County. Lake level fluctuations seem to be required to facilitate dispersal and destroy competition from weed species. The Okeechobee gourd requires trees or shrubs (typically pond apple, but also willow or cypress) to support vines above rising water levels during the wet season. The gourd also occurs on elevated, sunny alligator nests along Lake Okeechobee. The occurrence of gourds is temporary; therefore, they may disappear from a known location and reoccur when suitable conditions occur.

2.11.5.13 Johnson's Seagrass

The threatened Johnson's seagrass (Halophila johnsonii) has been found growing only along approximately 200 km of coastline in southeastern Florida from Sebastian Inlet, Indian River County to northern Key Biscayne. This narrow range and apparent endemism indicates that Johnson's seagrass has the most limited geographic distribution of any seagrass in the world.

Johnson's seagrass occurs in dynamic and disjunct patches throughout its range. Growth appears to be rapid and leaf pairs have short life spans while horizontally spreading from dense apical meristems (Kenworthy 1997). Kenworthy suggested that horizontal spreading rapid growth pattern and a high biomass turnover could explain the dynamic patches observed in distribution studies. New information reviewed in Kenworthy (1999, 1997) confirms H. johnsonii's limited geographic distribution in patchy and vertically disjunct areas between Sebastian Inlet and northern Biscayne Bay.

Within its range, Johnson's seagrass critical habitat designations have been designated for 10 areas: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel; a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel; a portion of the Indian River Lagoon near the Fort Pierce Inlet; a portion of the Indian River Lagoon, north of the St. Lucie Inlet; a portion of Hobe Sound; a site on the south side of Jupiter Inlet; a site in central Lake Worth Lagoon; a site in Lake Worth Lagoon, Boynton Beach; a site in Lake Wyman, Boca Raton; and a portion of Biscayne Bay.

The essential features of habitat appear to be adequate water quality, salinity, water clarity and stable sediments free from physical disturbance. Important habitat characteristics include shallow intertidal as well as deeper subtidal zones (2-5 m). Water transparency appears to be critical for Johnson's seagrass, limiting its distribution at depth to areas of suitable optical water quality (Kenworthy 1997). In areas in which long-term poor water and sediment quality have existed until recently, such as Lake Worth Lagoon, H. johnsonii appears to occur in relatively higher abundance perhaps due to the previous inability of the larger species to thrive. These studies support unconfirmed previous observations that suspended solids and tannin, which reduce light penetration and water clarity, may be important factors limiting seagrass distribution. Good water clarity is essential for Halophila johnsonii growth in deeper waters.

Johnson's seagrass occurs over varied depths, environmental conditions, salinities, and water quality. In tidal channels H. johnsonii is found in coarse sand substrates, although it has been found growing on sandy shoals, in soft mud near canals and rivers where salinity many fluctuate widely (Virnstein et al. 1997). Virnstein has called Johnson's seagrass a "perennial opportunistic species." Within study areas in the Indian River Lagoon, H. johnsonii was found by itself, with other seagrass species, in the intertidal, and (more commonly) at the deep edge of some transects in water depths of up to 180 cm. H. johnsonii was found shallowly rooted on sandy shoals, in soft mud, near the mouths of canals, rivers and in shallow and deep water (Virnstein et al. 1997). Additionally, recent studies have documented large patches of Johnson's seagrass on flood deltas just inside Sebastian Inlet, as well as far from the influence of inlets (reported at the workshop discussed in Kenworthy, 1997).

These sites encompass a wide variety of salinities, water quality, and substrates. Areas of concern include seagrass beds located in proximity to rivers and canal mouths where low salinity, highly colored water is discharged. Freshwater discharge into areas adjacent to seagrass beds may provoke physiological stress upon the plants by reducing the salinity levels. Additionally, colored waters released into these areas reduce the amount of sunlight available for

photosynthesis by rapidly attenuating shorter wavelengths of Photosynthetically Active Radiation.

Continuing and increasing degradation of water quality due to increased land use and water management threatens the welfare of seagrass communities. Nutrient over enrichment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off stimulates increased algal growth that may smother Johnson's seagrass, shade rooted vegetation, and diminish the oxygen content of the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities.

2.11.6 State-Listed Species

Many wading birds that utilize the marsh zone and adjacent wetlands are listed by the State of Florida as threatened (Florida sandhill crane) or species of special concern (snowy egret, little blue heron, limpkin, tricolored heron, and white ibis). They frequently forage along the lake margins or canals. Eleven or more active rookeries of wading birds occur along lands near Lake Okeechobee with many containing state-listed wading birds such as little blue heron, white ibis, and tricolored heron. Also, Lake Okeechobee is utilized for foraging and resting areas by migratory birds and waterfowl along the Atlantic flyway.

The FWC compiles wading bird rookery data within the State of Florida. Three wading bird rookeries were identified within the EAA, but no rookeries were identified within Compartment A. One rookery was located west of the North New River Canal and contained two state-listed species, little blue heron and tri-colored heron, based on a survey in the spring of 1999. In another rookery, located south of the Hillsboro Canal, just east of the North New River intersection, three state-listed wading bird species (little blue heron, tri-colored heron and white ibis) were observed, also during the 1999 survey. The third rookery, located along the southern shore of Lake Okeechobee, did not contain listed wading birds

Several state listed species were observed on the project site during field surveys of Compartment A (USFWS 2005). Specifically, the Florida burrowing owl, which is also guaranteed protection under the Migratory Bird Treaty Act, was observed. Although burrows were not observed, suitable habitat for the owl may exist on agricultural lands and canal banks.

2.12 ESSENTIAL FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act, 16USC 1801 et seq. Public Law 104-208 reflects the Secretary of Commerce and Fishery Management Council authority and responsibilities for the protection of

Essential Fish Habitat (EFH). Federal agencies that fund, permit, or carry out activities that may adversely impact EFH are required to consult with the National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH. In conformance with the 1996 amendment to the Act, the information provided in this Integrated Environmental Impact Statement (EIS) will comprise the required EFH assessment and has been coordinated with NMFS.

The EFH located within the area affected by the EAA Storage Reservoir occur within the St. Lucie River Estuary and Southern Indian River Lagoon on the Atlantic coast and the Caloosahatchee River Estuary on the Gulf coast.

The St. Lucie River Estuary and the Southern Indian River Lagoon are within the jurisdiction of the South Atlantic Fishery Management Council (SAFMC) and are located in areas designated as EFH for wormrock, live bottom habitat, red drum, shrimp, spiny lobster, and the snapper-grouper complex. In addition, the nearshore hardbottom habitat outside of the St. Lucie and Ft. Pierce Inlets areas is designated as Essential Fish Habitat-Habitat Areas of Special Concern (EFH-HAPC) for the snapper-grouper complex.

The Caloosahatchee River Estuary is within the jurisdiction of the Gulf of Mexico Fishery Management Council (GMFMC). In the estuary EFH is defined as all estuarine waters and substrates (mud, sand, shell, rock and associated biological communities), including the sub-tidal vegetation (seagrasses and algae) and the adjacent inter-tidal vegetation (marshes and mangroves). The estuary provides EFH for adult and juvenile brown shrimp (Penaeus aztecus), pink shrimp (Penaeus duorarum), white shrimp (Penaeus setiferus), gray snapper (Lutjanus griseus), red drum (Sciaenops ocellatus), Spanish mackerel (Scomberomorus maculates), spiny lobster (Panulirus argus), stone crab (Menippe mercenaria), and gulf stone crab (Menippe adina).

2.13 WATER MANAGEMENT

This sub-section summarizes the existing water management system in the Study Area. The summary addresses the status of the Everglades Program, as defined in the 1994 Everglades Forever Act (EFA), and its implications for the Project. Also covered are hydrography, drainage basins, water management practices, and the major groundwater/hydrogeologic features in the Study Area.

Currently, water levels in Lake Okeechobee are regulated by a complex system of pumps and locks. The regulation schedule attempts to achieve the multiple-use purposes as well as provide seasonal lake level fluctuations. The schedule maintains a low lake stage to provide both storage capacity and flood protection for surrounding areas at the beginning of the summer wet season. At the end of

the wet season, the beginning of winter, lake levels are higher to store water for the upcoming spring dry season. The general plan of operation for Lake Okeechobee is based on the following: 1) flood protection from lake waters and water driven by hurricane winds on lands adjacent to the lake; 2) maintenance of an eight-foot navigation channel across Lake Okeechobee, as part of the Okeechobee Waterway; and, 3) storage of water to supply needs of the Lake Okeechobee service area.

Flood control improvements around Lake Okeechobee consist of a system of approximately 1,000 miles (1,600 km) of encircling levees, designed to withstand a severe combination of flood stage and hurricane occurrence, plus the regulatory outlets to the St. Lucie Canal and the Caloosahatchee River. The design discharge of Moore Haven Spillway to the Caloosahatchee River is 9,300 cubic feet per second (cfs) [260 cubic meters (m3)/second (sec)]; that of St. Lucie spillway is about 16,000 cfs (450 m3/sec). Following removal of local runoff from the agricultural areas south of the lake, an additional regulatory capability of several thousand cfs is available through the Miami, North New River, Hillsboro, and West Palm Beach Canals by pumping into the three WCAs.

The EAA is located south of Lake Okeechobee within a belt of highly organic hydric soils originally deposited by the historic Everglades wetland called the "River-of-Grass." The organic soils have served as a fertile agricultural area since they were initially drained. Over-drainage and environmental impacts eventually led to the completion of the C&SF Project. The C&SF Project's intention was to provide water storage in the WCAs and to better control water levels in the Everglades for multiple purposes. As a result, the EAA contains an elaborate canal system. The construction of canals, levees, and roads has eliminated the historical freshwater sheet flow and resulted in changes in the timing and quantity of flow within the system that have influenced water quality conditions and impacted the downstream EPA.

The revised water management system allowed extensive agricultural development in the EAA. However, environmental effects continued to be observed in the downstream areas of the remaining Everglades ecosystem. Increased loading of phosphorus from the EAA was found to be causing unacceptable ecological changes to the WCAs and the ENP, which comprise the EPA. The Everglade Forever Act required that all waters discharged to the EPA meet applicable water quality standards. Phase I water quality measures included design and construction of a number of STAs by SFWMD. These STAs were intended to provide an interim reduction in the observed phosphorus loads. In addition, a broad suite of agricultural best management practices (BMPs) were implemented to further lower phosphorus discharges to the EPA. Based on a phosphorus water quality criterion of 10 µg/L, additional activities were determined to be necessary to ensure eventual compliance within the EPA. A

long-term plan for achieving this compliance was published by SFWMD in October 2003 (Burns & McDonnell, 2003).

2.14 WATER QUALITY

2.14.1 Overview

Water quality information focuses upon the EAA as the area of expected primary impacts. However, the water quality of the larger area is dependent on Lake Okeechobee water quality to the extent that these waters are released to the various receiving waters. Lake Okeechobee water is conveyed to receiving water bodies by canals and primary and secondary tributaries. Receiving waters are St. Lucie and Caloosahatchee River Estuaries, including Indian River Lagoon and Charlotte Harbor, and the northern WCAs.

Nutrients such as phosphorous and nitrogen compounds are a concern in the WCAs and EPA. When there are sufficient levels of both nutrients present, cattails and other invasive species displace native sawgrass. There are many natural and human sources of nitrogen compounds. However, vegetation growth is limited by the comparative lack of phosphorous compounds. These come primarily from agricultural fertilizers and decomposition of the peat soils in the area. Decomposition of peat soils in the EAA is accelerated by continued agricultural use. Thus, phosphorous is a parameter of particular concern regarding water from Lake Okeechobee and the EAA.

Agricultural BMPs were implemented in the EAA in 2000, with the result of improving water quality. However, this area remains a primary source of pollutants for the WCAs. The WCAs form the remnant wetland communities for the northern section of the Everglades system. These areas have been isolated from contiguous lands by a series of levees and pump stations. Water moving south from the lake and EAA is pumped through the WCAs, thereby making these areas nutrient filters for downstream basins. A highly altered hydroperiod results from the presence of various levees and pumping schedules. These factors may worsen water quality conditions in the WCAs and are consistent with the general degradation of water quality in areas along the canals and pump stations when compared to conditions in the central portions of the basins. Construction of STAs upstream of the WCAs will serve to improve water quality conditions through time; however, other problems may persist.

The L-8, West Palm Beach, Hillsboro, North New River, and Miami Canals from Lake Okeechobee to the L-4, 5, 6, and 7 Canals, which roughly define the EAA, have poor water quality with extremely high nutrient and low dissolved oxygen levels. Other problems include pesticides, biological oxygen demand, bacteria, and suspended solids. Fish kills occur periodically in the West Palm Beach Canal after heavy rains drain from the Chemair Spray hazardous waste site.

2.14.2 Monitoring Programs

SFWMD maintains a water quality monitoring network for surface waters within and at the boundaries of the EAA. These surface water samples have been analyzed for multiple constituents. The samples have been acquired at various frequencies from a variety of sampling stations over the years. These water quality data are compiled in SFWMD's database DBHYDRO and available through Internet search (http://www.sfwmd.gov/org/ema/dbhydro/). Additional data sources include: USEPA, the USGS, FDEP, and numerous public and private research and monitoring efforts.

FDEP has defined most of the primary and secondary canals within the EAA (Miami, Hillsboro, North New River, West Palm Beach, Bolles and Cross Canals) as Class III Waters with a designated use of "recreation, propagation and maintenance of healthy, well-balanced population of fish and wildlife." Agricultural canals are regulated as Class IV Waters designated for "agricultural water supply." A summary of applicable water quality criteria for Class III and IV Waters of the state as defined in Section 62-302.530, FAC, may be found in Appendix C.

While most of the surface water quality monitoring has been performed by SFWMD, other agencies have cooperated in the monitoring effort, including USEPA, USGS, FDEP, and the USACE. Surface water samples and field measurement data were collected near the water surface. Samples and data generally were collected at routine frequencies so they were not biased by water management practices or season of the year. Analytical procedures were typically USEPA methods that were approved by CERP oversight.

Information in this sub-section is intended to be general summary data. It should be useful in providing a broad understanding of water quality in the various water bodies of interest. It must be noted that any monitoring program has limitations with regard to the detail to which data may be interpreted. For example, water samples and field measurement data were routinely collected near the water surface. Sampling at the surface of a water body may or may not yield analytical data that reflect the water quality of the entire water column. The water columns in some Florida canals have been seen to stratify, allowing substantial water quality (e.g., dissolved oxygen, nutrients) differences to develop in the near-surface water and water closer to the canal bottom. Please see Appendix C for more detail on water quality data.

2.14.3 Water Quality Parameters of Interest

Field measurement parameters include specific conductance, pH, and dissolved oxygen. Specific conductance, the ability of a water sample to carry an electrical

current, provides a measure of the dissolved solids such as sodium chloride, calcium carbonate, and sulfate, which have an electrical charge when they dissolve. There are levels of salt that will adversely affect aquatic plants and animals. This level is different for each species. Measuring pH determines how acidic or basic the water is. Aquatic plants and animals are generally only able to tolerate a narrow range of pH values. Oxygen is necessary for aquatic plants and animals to live and either dissolves into water at the water-and-air interface or during photosynthesis by aquatic plants. Low dissolved oxygen may be an indicator of high organic loadings and is associated with foul smelling water.

Solids and chemical ions are determined during laboratory testing. These tests provide general water quality information. Suspended solids and turbidity are often related. The suspended solids test measures particulates that are in the water column at the time of sampling. These solids may be microscopic plants (algae), fine silt, and/or clay suspended by wave action or water movement. Turbidity measures the light scattering caused by particulates in the water column. Light scattering may limit the amount of light that bottom dwelling plants receive and may reduce the aesthetic appeal of a water body.

Major ions of interest are chloride, sulfate, calcium, sodium, and iron. These chemical constituents are normally present in natural surface waters, but may sometimes limit water use when present in excess, causing problems with water hardness, color and staining, and excessive saltiness. Alkalinity is important for measuring carbonate and other acid and base buffering ions in natural waters.

Nitrogen and phosphorus are typically the most important nutrients with regard to aquatic plant growth. In water, excessive growth of plants cannot be sustained and may act to deplete dissolved oxygen. Nitrogen (N) in the forms of nitrate (NO3) and nitrite (NO2) are commonly analyzed together with a single test and the results are often identified as NOx-N. Ammonia and NOx-N are available for plant uptake. Total Kjeldahl nitrogen measures ammonia nitrogen and nitrogen incorporated into organic compounds and plant and animal cells but not NOx-N. Ortho phosphate (PO4 or oP) and total dissolved phosphorus (TDP) are forms of phosphorus that are not bound in plant and animal cells or water column particulates and may be available for plant uptake. The total phosphorus (TP) test measures oP, TDP, and phosphorus bound in plant and animal cells and water column particulates.

Pesticides and mercury can have detrimental effects on aquatic life. Poisons, such as pesticides and mercury, can also have direct adverse effects on human health. Ametryn, atrazine, simazine, and toxaphene are pesticides of interest in the area. Recent post-remediation testing of the Woerner Farm #3 property located in the extreme northern portion of the Compartment A footprint yielded elevated levels of toxaphene. The USFWS has performed an environmental risk

assessment and determined that toxaphene, at possible action levels, is widely distributed in the shallow soil layer within the Woerner Farm #3 area. In the event that the FDEP affirms that potentially harmful levels of toxaphene are in the soil, it will likely mandate additional remediation (by the responsible party) for site closure and for issuance of a water quality certification (WQC) for operations. However, no determination has been made and the USFWS is presently coordinating directly with the SFWMD in order to achieve resolution to this matter. Additionally, testing for mercury includes total mercury and total methyl mercury, which is more likely to be accumulated in the food chain.

2.14.4 Lake Okeechobee and the EAA

Water quality data for the different system components for the Study Area are presented in Table C-8 (Appendix C) as arithmetic means of data acquired after 2000. Since algae tend to increase water column pH during the oxygen-forming photosynthesis process, it is common to see higher levels of dissolved oxygen occurring in water with higher pH. Lake Okeechobee had the highest dissolved oxygen and pH averages for the area waters. The STAs, WMAs, and EPA had lower values, perhaps reflecting shading of surface water by emergent vegetation that would contribute little oxygen to the water column.

Dissolved solids, as indicated by specific conductance, averaged highest in the secondary and agricultural canals. Nutrients, solids, and ionic chemicals also tended to have the highest concentrations in these canals. These elevated averages may be caused in part by turbulence created during pumping activities in these shallow canals that might re-suspend solids that had previously settled to the bottom. Of all of the parameters shown in the above table, only specific conductance and dissolved oxygen (DO) were found to have averages that exceed Florida water quality standards for their respective classification. Water in the agricultural canals averaged at 1600 uS/cm which exceeds the applicable Class IV criterion of 1275 uS/cm. As stated above, the recorded levels may be caused by pump-related turbulence. For both primary and secondary canals, DO averages fell short of the Class III (minimum) criterion of 5.0 mg/l with readings of 4.87 and 4.06, respectively. These lower levels are likely attributed to biochemical oxygen demand (BOD) resulting from the biological response to organic chemical laden runoff. In an effort to minimize low DO occurrences, the detailed design and long term project operations will investigate and, if practicable, may implement actions to minimize low DO concentrations.

The STAs, WMAs, and EPA averaged lowest for nitrogen and phosphorus forms. Emergent plant communities in these areas appear to effectively reduce the concentrations of nutrients in the water column. Pesticides and mercury were found in most locations where sampling occurred.

2.14.5 Caloosahatchee River Basin

Water quality conditions are degraded in the upper and lower areas of the Caloosahatchee River basin due to agricultural and urban runoff, respectively. The channelized section of the river also shows degraded water quality conditions, due to agricultural inputs, as compared to tributaries lying in less developed areas of the basin. Problems associated with the degraded areas of the basin are typified by low dissolved oxygen levels, elevated conductivity, and decreased biodiversity. Conditions in the urbanized sections of the basin are influenced by non-point stormwater flows, and are manifested in the river by elevated chlorophyll levels, algal blooms, periodic fish kills, and low dissolved oxygen levels. Although wastewater discharges remain a problem, the estuary is presently more seriously affected by high-nutrient waters from the river and tributaries, and stormwater runoff from cities. Nutrient and chlorophyll levels are high, and small algal blooms occur regularly.

2.14.6 St. Lucie River Basin

Water quality conditions along the St. Lucie River are rated as good in less developed areas of the basin. However, conditions are degraded in urbanized areas and along the extensive network of canals that drain this area. The worst water quality conditions in the Martin and St. Lucie County area are reported in the St. Lucie River and the canals leading from the EAA. As described above, the major sources of pollution in this basin are urban runoff, agriculture, rangeland runoff, boat discharge, and sewage overflows. Water quality in the south section of the Indian River Lagoon was rated as fair by a National Estuary Program technical report (Woodward-Clyde Consultants, 1994).

2.14.7 Water Conservation Areas

The 1996 305(b) report classifies water quality conditions as good in the northernmost areas of WCA-2 transitioning to a fair condition throughout most of the remainder of the basin. Poor water quality conditions are shown to exist along the L-38E Canal. Water quality in WCA-3A are rated as fair north of the county line, and are rated as good on the south side of the line. The ten-year trend does not show significant changes have occurred in the basin.

2.15 SOCIOECONOMICS

2.15.1 EAA Socioeconomic Characteristics

The proposed storage reservoir is located in the southern portion of the EAA. Eleven census tracts are partially located within the EAA, with Tracts 7903 in Palm Beach County and 0200 in Hendry County being only partially within the target area (Figure 2-3). Three incorporated population centers are within the

EAA: the Cities of Pahokee, Belle Glade, and South Bay. These centers have a significant impact on the demographics of certain tracts and the EAA as a whole. The total estimated population in the EAA in 2000 was 42,265 persons.

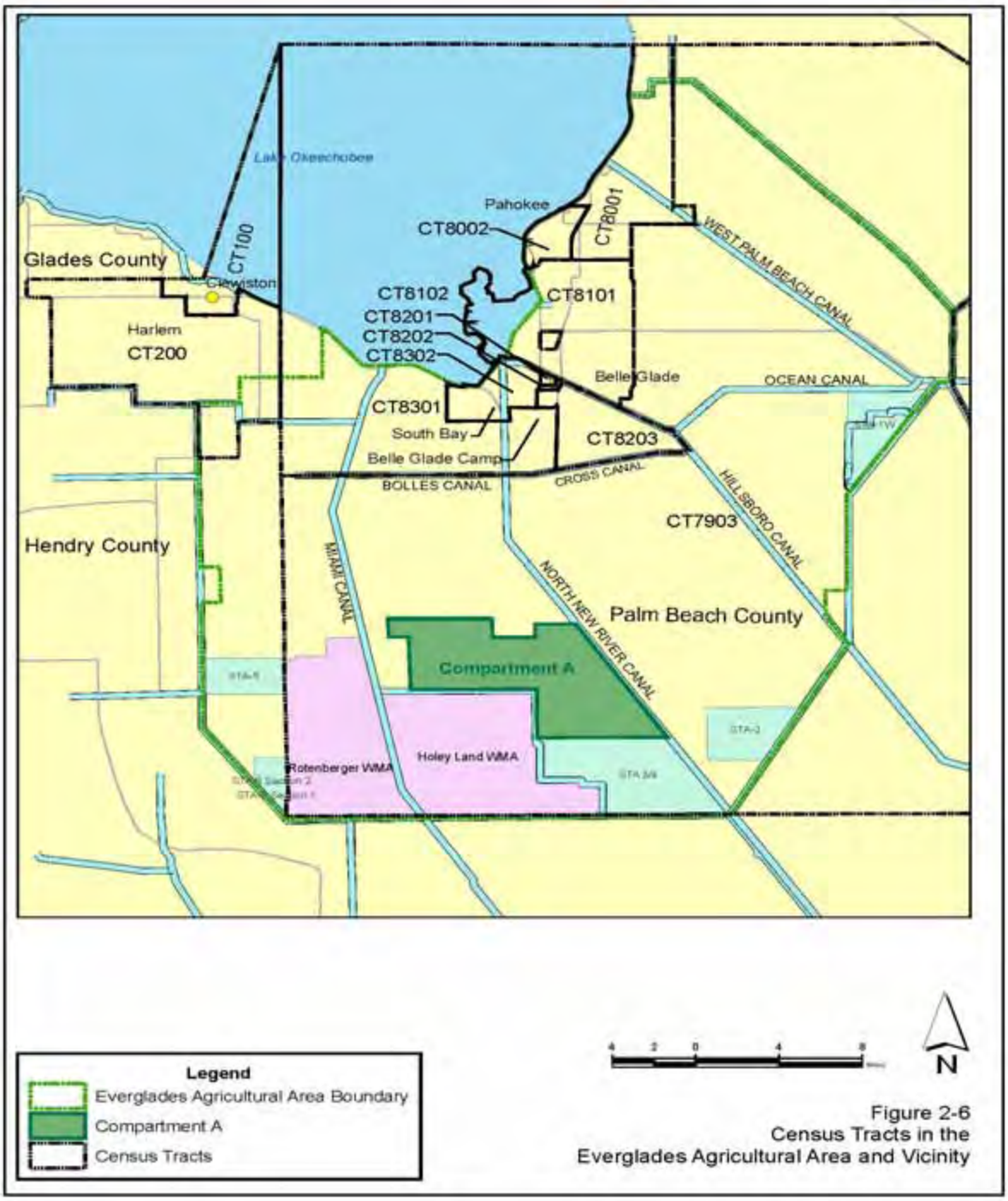

FIGURE 2-3: CENSUS TRACTS IN THE EVERGLADES AGRICULTURAL AREA AND VICINITY

From a socioeconomic perspective this area is generally "very depressed," but has significant community cohesion. It is an aging area that is likely to continue to see a loss of working age, educated population - typical of patterns seen in many rural areas throughout the United States. There is a high concentration of minority individuals, both African-Americans and Hispanics, with their numbers far exceeding non-minorities. Income levels are well below state averages with one-third to one-half of the families living in poverty.

Educational achievement in the EAA is low compared to Florida averages, with less than 10% of the area's adults having any formal education beyond high school and only about one-half having graduated from high school. About one-fourth of the adults did not complete ninth grade.

While Florida has experienced a population increase of almost 25% in the ten years between the 1990 and 2000 censuses, the EAA population decreased 5% from 44,700 to 42,265 persons. The population decline most likely reflects the mechanization of agricultural processes and out-migration of youth (USACE and SFWMD, 2003). Reflective of the population decline, the EAA experienced between 1990 and 2000, the area has seen a decrease in families. Nine of the eleven census tracts saw a decrease of 10% to 20% in the number of families. The number of families in the three municipalities also declined.

The southern and central sections of the EAA have a very low population. Table 2-3 provides an overview of the socioeconomic characteristics within each of the census tracts in the EAA.

A high percentage of the population within the EAA is clustered near Lake Okeechobee, within and adjacent to the incorporated areas. Census tracts comprising over 80% of the surface area in the EAA contain just over 4% of the total population.

When viewing the 2000 income data for the EAA as a percentage of Florida incomes, the relative poverty of the EAA population is very visible. Median income levels of eight of the eleven tracts are less than three-quarters of Florida's median household and family income. Per capita income differences are more severe, with six of the tracts having less than one-half of the statewide average per capita income. Additionally, the per capita income of Florida is higher than that of all tracts in the EAA. The disparity between the Florida values and the individual tract values is much greater than in 1990.

Service-oriented occupations comprise the majority of employment in the EAA. Farming occupations represent a small percent of the workforce, reflective of the modernization of farming operations, while production, mostly related to agriculture, continues to be a major occupation in the EAA.

TABLE 2-3: EAA SOCIOECONOMIC CHARACTERISTICS

Area	1990 Population	2000 Population	Percent Change 1990 - 2000	Persons per Square Mile in 2000	Median Household Income in 2000	Per Capita Income in 2000
Florida	12,937,926	15,982,378	23.5%	296	$ 38,819	$ 21,557
EAA	44,700	42,265	-5.4%	44		
Hendry County Tract 200	8,535	7,506	-12.1%	102	$ 31,760	$ 13,047
Palm Beach Co. Tracts						
7903	675	5,729	748.7%	5	$ 58,770	$ 21,177
8001	3,459	3,727	7.7%	104	$ 23,081	$ 9,303
8002	6,377	5,360	-15.9%	836	$ 23,625	$ 10,301
8101	5,554	6,229	12.2%	141	$ 33,906	$ 12,756
8102	1,137	1,091	-4.0%	1254	$ -	$ 8,022
8201	5,433	4,355	-19.8%	9467	$ 17,004	$ 8,776
8202	3,295	2,976	-9.7%	8043	$ 15,000	$ 8,056
8203	4,626	4,763	3.0%	258	$ 28,409	$ 12,592
8301	2,154	1,737	-19.4%	22	$ 24,125	$ 7,676
8302	4,130	4,521	9.5%	419	$ 25,227	$ 9,239
Cities						
Belle Glade	16,177	14,999	-7.3%	3226	$ 22,715	$ 11,159
Pahokee	6,822	5,822	-14.7%	1080	$ 26,731	$ 10,346
South Bay	3,358	3,895	16.0%	1437	$ 23,558	$ 9,126
* Derived from the U.S. Census 1990 and 2000. Data for census tracts 0200 and 7903						
is not representative of the EAA area because large portions of these tracts lie						
outside the target area. Tract 8102 has no households or families.						
Sources: US Census 1990; US Census 2000; USACE, SFWMD, 2003						

2.15.2 Socioeconomic Characteristics of the Reservoir Storage Area

Analysis of 2000 block level census data reveals a total of 20 persons within the footprint of Compartment A. While the land area of the proposed reservoir storage areas totals 35,526 acres or 5.7% of the EAA, population residing within the storage reservoir area represents 0.05% of the EAA total population. The purchase agreement between the DOI, SFWMD and the landowners allowed farming to continue on most of the land until March 31, 2005. After March 2005, land may be leased for agricultural purposes until needed by USACE for restoration purposes.

2.16 LAND USE

2.16.1 Land Use in the EAA

The EAA is situated to the south of Lake Okeechobee within portions of Palm Beach and Hendry Counties. Bordering the EAA to the south and east are WCA-1 (otherwise known as the Arthur R. Marshall Loxahatchee National Wildlife Refuge), WCA-2, and WCA-3. The EAA encompasses an area of 620,797 acres. Included in the EAA are the Rotenberger and Holey Land WMAs (approximately 25,000 acres and 35,500 acres, respectively) and six STAs (totaling approximately 36,400 acres).

The FWC land cover data is presented more fully in the previous Plant Communities section. Currently, land in the EAA is primarily in agricultural production, with sugarcane being the primary crop. Secondary agricultural uses include vegetables, rice, sod, and improved pasture. The dominant land use in the EAA, based on the FWC land cover data, is sugarcane, which utilizes 68% of the land area. Bare Soil/Clearcut covers almost 12% of the remaining land area and sawgrass marsh another 6.5%. No other land cover classes contain more than 3% of the land area.

The EAA began agricultural production in the early 20th century. However, it was not until the first dredging of Lake Okeechobee in 1919, the opening of the Palm Beach Canal, and the freeze of February 3, 1917, that farming emerged as an important economic activity in the area. The initial draining of the rich "muck" soils created opportunities for vegetable production.

Most of the land was owned by either the State of Florida or the Southern Land and Timber Company. Initially, farmers were allowed to farm the land without purchasing the property or paying rent. This resulted in the development of agricultural settlements along the southern shore of Lake Okeechobee. These settlements evolved into the three municipalities of Pahokee, Belle Glade, and South Bay, with incorporations beginning as early as 1922.

A hurricane that battered the area in September 1928 had far-reaching impacts on the area's land use. The hurricane's death toll of over 1,800 persons and extensive physical damage, caused by wind-driven waters of Lake Okeechobee overflowing into populated areas, led to the construction of the Herbert Hoover Dike around Lake Okeechobee to control future flooding.

After construction of the Herbert Hoover Dike, farming activities significantly increased. The EAA was formally created in the 1940s when one-half of the Everglades Economic Region, consisting of 1.6 million acres, was drained for agriculture and urban development.

Sugarcane production began with the construction of the Clewiston Sugar Mill in 1929. Prior to the Cuban revolution of 1959, 50,000 acres of the EAA were devoted to sugar cultivation. Imposition of the Cuban Embargo in the early 1960s, the arrival of Cuban refugees skilled in sugar production, and abolishment of the production limitation imposed by the "Sugar Act" in 1974, enabled the EAA to become the leading cane sugar production area in the United States. In 1995, over 500,000 acres were devoted to sugarcane production.

In 2002, the Study Area contained about 505,000 acres in agricultural products cultivation, about 90% of which is in Palm Beach County and 10% in Hendry County. In the 2000-2001 fiscal year, approximately $1.2 billion in agricultural sales were produced in the EAA, representing about one-seventh of Florida's total agricultural sales. The estimated $1.2 billion in sales is believed to result in a total of $2.8 billion in the two counties' economies, based on applied multipliers.

About nine out of every ten (86.8%) crop yielding acres in the EAA are associated with sugarcane. The remaining acreage is split between rice, sod, row crops, and other agricultural uses. Table 2-4 shows acreage of agricultural uses in the EAA.

TABLE 2-4: ACREAGE BY CROP IN THE EAA.

Crop	Palm Beach County Acreage	Hendry County Acreage	Total Acreage	Percent of Total Acreage
Sugarcane*	423,358	45,442	468,800	92.7%
Row**	16,347	—	16,347	3.2%
Sod	9,846	—	9,846	1.9%
Nursery	618	—	618	0.1%
Pastures	1,075	1,884	2,959	0.6%
Miscellaneous	4,031	2,939	6,970	1.4%
Total	455,275	50,265	505,540	100.0%
* Includes rice and corn grown as rotation crops.				
** Includes 1,814 non-productive acres associated with service area for row crops.				
Source: USACE and SFWMD, 2003.				

SFWMD anticipates a decline in sugarcane production within the EAA from 529,920 acres (1995 condition) to 491,520 acres (2050 condition) due to the purchase of agricultural land for restoration projects. Sugarcane production will also be directly related to future U.S. government import/export policies and relationship with Cuba.

There are six sugar mills and one refinery (South Bay) currently operating in the EAA, with an additional mill and refinery in Clewiston also serving the area. The combined capacity of these mills is over 17 million tons. Three major entities - U.S. Sugar Corporation, Florida Crystals Corporation, and Sugarcane Growers Cooperative (SCGC) - provide the majority of the sugarcane production in the EAA.

2.16.2 Land Use in Compartment A

Land use in this area is comprised almost exclusively of Sugarcane (77%) and Bare Soil/Clearcut (20%). Other agricultural uses, wetlands, uplands, urban and extractive uses comprise the remaining three percent of the land area.

2.16.3 Agriculture

There is a large amount of agricultural lands surrounding Lake Okeechobee. About 505,000 acres are farmed in the EAA (UFBEBR, 2002), and sugarcane was harvested from about 86.8% of that acreage in 2002. Much of this acreage is likely categorized as unique farmland based upon its location, growing season, and high value crops, including sugarcane and vegetables. Continued agricultural production in the EAA has become increasingly controversial. Some of the factors that may affect EAA agriculture include, water quality concerns, soil subsidence, and urban encroachment. The water quality concerns, particularly phosphorus loading, are being addressed through best management practices, stormwater treatment areas, and growing use of organic farming practices and rice cultivation in rotation with sugarcane production. Although sugarcane cultivation in the EAA has come under some sharp criticism in recent years, sugarcane is recognized as the most appropriate crop for this region. Sugarcane requires less phosphorus fertilizer than other crops grown in the EAA (Sanchez, 1990), and sugarcane has been found to remove 1.79 times more phosphorus than was applied as fertilizer (Coale, et al., 1993). Florida sugarcane only requires small amounts of pesticides due to disease resistant and tolerant cultivars, and cultivation instead of herbicides for weed control. Sugarcane also tolerates greater variability in water table levels, allowing for more flexible water management strategies (Glaz, 1995).

2.17 RECREATIONAL RESOURCES

Several recreational opportunities exist on public lands within the EAA, such as the Holey Land WMA, Rotenberger WMA, and Lake Harbor Public Small Game Hunting Area. These offer significant recreational opportunities for visitors and tourists to the area. Each is different, but likely shares a patron base interested in sports recreation and outdoors activity. Many of the areas are adjacent to the proposed storage reservoir.

2.17.1 Holey Land Wildlife Management Area

Holey Land WMA contains approximately 35,000 acres and is operated by FWC. Holey Land WMA is bordered by Compartment A to the north and to the east. Primary recreational activities associated with the WMA are hunting, fishing, camping, hiking, and bicycling along L-5 and Miami Canal levees. Future activities or development may focus on improved access, wildlife viewing, and other non-consumptive activities.

The environment of Holey Land WMA has changed since 1991 due to rehydration under the Holey Land Restoration Project. Since hydrologic restoration began in 1991, Holey Land's recreational use has shifted from hunting toward fishing in perimeter canals and waterfowl hunting. Fishing is also allowed at the G-204, G-205, and G-206 culverts. Access for motorboats and airboats is provided at the G-200 and G-201 pump stations.

Game species occurring in Holey Land include white-tailed deer, common snipe, hog, and marsh rabbit; blue-winged teal, mottled ducks, and other game waterfowl which are found in sloughs in the NE corner of the WMA. Limited alligator hunting is currently administered on Holey Land WMA as part of the FWC's Public Waters Alligator Hunt program.

The direct economic contribution to the economy by recreational use of the Holey Land WMA was estimated at $137,606 for 2001. The net contribution in total consumer revenue of Holey Land during that same year was estimated at between $65,659 and $131,138.

2.17.2 Rotenberger Wildlife Management Area

Rotenberger WMA encompasses approximately 25,000 acres and is also operated by FWC. Compartment A is located to the East. Holey Land WMA, STA-5, and STA-6 also border the site.

Recreational activities at Rotenberger WMA include hunting, fishing, and camping. FWC seeks to expand the range of public use in the future by improving access and informing the public of opportunities for wildlife viewing and other non-consumptive activities (FWC, 1997b).

Deer hunting is the primary public use at Rotenberger. Other game species include wild hogs, snipe, and waterfowl. Fishing is generally limited to borrow pits along Powerline levee and Miami Canal bank. While hydropattern restoration may result in increased production of forage fish for wading birds, there will only be a few miles of distribution canal within the area, making fishing from motorboats limited.

2.17.3 Stormwater Treatment Areas

Within the EAA, there are a total of five STAs. All five of these STAs are in flow through operations. One of these STAs, STA-3/4, is located adjacent to the proposed EAA storage reservoir. A sixth STA, STA-1E, although not physically located in the EAA, upon completion, will receive EAA runoff via the STA-1 Inflow and Distribution Works project located between STA-1W and STA-1E. These man-made wetlands offer a potentially valuable recreational resource. Recreational plans are being developed for the STAs to ensure that recreational uses are consistent with the primary use of the STAs- to achieve specific water quality improvements. To date, hunting has only been permitted in STA-5. The annual FWC report for the 2002 to 2003 waterfowl hunt season indicated that for this particular STA, 500 hunters were permitted and 1,715 ducks were harvested. Supervised bird watching events have also been held recently in some of the STAs.

The projects in the October 27, 2003 Everglades Protection Area Tributary Basins Long-Term Plan for Achieving Water Quality Goals (Long-Term Plan) were designed to achieve compliance with the water quality standards for the EPA by December 31, 2006. One of the key assumptions during the development of the Long-Term Plan was that Compartments B and C would be under consideration for use as part of the EAA Storage Reservoirs Project through Fiscal Year (FY) 2010 and for this reason should not be considered for other Everglades restoration uses until FY 2011. Subsequent to completion of the Long-Term Plan, it was determined that all of the EAA Storage Reservoirs Project's water storage goals could be achieved on Compartment A, and that using Compartments B and C would not be a cost effective way to meet the storage objectives of the EAA Storage Reservoirs Project (Phase 1 and 2). In light of the availability of the land in Compartments B and C, the SFWMD proposed to initially expand STA-2 with a new 2,000-acre Cell 4 and to initially expand STA-5 with a new 2,055-acre third flow-way to assist in maximizing the treatment effectiveness of the STAs in improving water quality entering the EPA. The SFWMD submitted a revised Part 2 of the Long-Term Plan to the FDEP in November 2004, requesting approval to revise the Long-Term Plan to include the addition of STAs on Compartments B and C, including the initial expansions. FDEP approved this request in December 2004. The initial expansions, which are currently in the design phase, are scheduled to start construction in January 2006 and to be flow-capable by December 31, 2006.

On a parallel path with the development of the EAA Storage Reservoirs Project PIR, the SFWMD is proceeding with the design of additional treatment areas on the remaining acreage of Compartments B and C to further assist in maximizing the effectiveness of the STAs in improving water quality entering the EPA. A Regional Feasibility Study which has been underway during 2005 is intended to

determine the optimal configuration and operation of the additional treatment areas on Compartments B and C. Because the results of the Regional Feasibility Study are not expected to be available until late 2005 assumptions about the final configuration and operation of the Compartments B and C STAs could not be included in the modeling for the EAA Storage Reservoirs PIR. Once the results of the Regional Feasibility Study are available, and an operating plan for the build out of STAs on Compartments B and C has been approved, this information can be incorporated into the EAA Storage Reservoirs Project phases as appropriate.

2.18 AESTHETICS

The Lake Okeechobee area is characterized by two types of scenery: open lake views, distinguished by a vast expanse of water with a vanishing horizon, and littoral zone viewsheds, characterized by various types of marshes, serving as a backdrop for wildlife. Hardwood swamps are found landward of the Herbert Hoover Dike (HHD), primarily on the west side of the lake. Significant exotic and invasive vegetation species (melaleuca, Australian pine, torpedograss, cattail) are intruding into stands of native species that tends to diminish biological diversity and existing aesthetics in those areas. In the Indian Prairie region of the lake, expansion of torpedograss and cattail particularly, have affected aesthetic qualities of the lake.

Some remnants of the historical willow swamp vegetation still can be found (Lodge, 1994). The HHD sideslopes are generally well grassed but contain some exotic and/or dead vegetation that degrades the distant uniform appearance. However, the dike affords a panoramic view of the lake from its crest, which can be magnificent during a sunset or sunrise. Shoreline trees generally enhance the rim canal aesthetics when viewed from a distance.

Melaleuca control programs have left hundreds of acres of dead melaleuca forest standing, which affects the overall aesthetics north of the Old Moorehaven Canal. Substantially altered water levels could have a detrimental effect on many aspects of the region's viewable resources. Development is a nominal aesthetic impact to this region's aesthetics at the present.

The visual characteristics of the EAA can simply be described as agricultural lands. The land is quite flat with few natural topographic features. Much of the visible topographic features are associated with canals, levees, and agricultural fields. Agriculture is dominated by sugarcane production, with lesser amounts of sod, vegetables, and rice production. The area is open with a low population density and few buildings or other structures. This use produces a uniform and organized appearance to the landscape. There are few trees or other non-

agricultural vegetation. The visual aesthetics are rather monotonous and of marginal value.

Along the St. Lucie Canal, much of the interior region is ditched for farming or range practices that have altered the natural vegetation and aesthetic resources of those areas. Many of the rural areas possess good scenic quality on a small scale. Orange groves, combined with scattered trees and forests, provide a tranquil backdrop to this rural agricultural setting.

The Caloosahatchee River Basin regional aesthetic overview is characterized by the Caloosahatchee River corridor, the Gulf of Mexico coastal plain, and surrounding uplands. The Caloosahatchee River is a linear body of water whose width allows observation of shoreline vegetation that includes texture, color, and wildlife varieties of interest and beauty. Minor urban impacts exist along the Caloosahatchee until the Fort Myers area where impacts increase noticeably. The coastal segments of the region possess a higher degree of aesthetic quality within the visual environment. State Parks, WMAs, and Wilderness Areas secure natural resources of prominent aesthetics. Much of the region's interior aesthetics are comprised of forested wetlands and irrigated pasturelands of moderate aesthetic quality. Many of the regional rural areas possess scenic quality on a small scale. Rural areas are largely pine forested with some oak, hickory, and gum associations. Air traffic noise is an increasing adverse aesthetic impact. Development pressures are an increasing concern to natural and aesthetic resources.

The visual landscape of the WCAs is overwhelmingly flat. Landscape features include typical canals, levees and prairie wetland communities. Access points to the interior of the areas are limited. WCA-1 is operated as a wildlife refuge and offers opportunities for observation of migratory game birds during winter months. Although some of the marshlands have been degraded in visual quality by over-flooding and loss of tree islands, other areas, such as the south-central region of WCA-3A, still preserve good examples of original, undisturbed Everglades' communities, with a mosaic of tree islands, wet prairies, sawgrass expanses, and deeper sloughs. From the elevated viewpoint of the Eastern Perimeter Levee system, the view westward to the marshes is panoramic, though mostly homogenous.

2.19 CULTURAL RESOURCES

Compartment A contained no areas considered to be high probability and it was determined a CRM survey was not necessary. Continuous agricultural use and both road and canal construction have heavily disturbed the area. A review of the Florida master Site Files, a site visit and consultation with the State

Historic Preservation Officer (SHPO) determined that it contains no areas considered high probability

Consultations with SHPO for Compartment A is complete, and it was determined there are no cultural concerns within either areas. A professional evaluation of Bolles/Cross Canal and 8PB50 was conducted and it was recommended that neither the canal nor 8PB50 site was historically significant. Final determination on Bolles/Cross Canal and 8PB50 with the SHPO is pending. Consultation with the SHPO for the North New River and Miami Canals is ongoing. An evaluation to determine the historical significant of each is necessary and project construction will not commence until coordination with SHPO, Miccosukee and Seminole tribes and all concerned parties is complete

The Project will comply with Section 106 of the National Historic Preservation Act of 1966 (PL89-665), as amended in 2000, it's implementing regulations (36 CFR 800) and the Archaeological and Historic Preservation Act of 1974 (PL93-291), as amended

2.20 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)

Compartment A is made up of 34 individual tracts of land. These properties or tracts comprise approximately 31,500 acres in the southern portion of the Everglades Agricultural Area in southwestern Palm Beach and southeastern Hendry Counties. Historical land use consisted primarily of cattle farming, sod, vegetable and sugar cane farming, fish nursery, aggregate mining, and tree nursery operations. The cumulative results of the Contamination Assessment Activities, Ecological Risk Assessment and Corrective Actions indicate that no further actions are required on the subject parcels within the proposed EAA Reservoir footprint.

According to the EAASR1 Environmental Summary Document (URS, 2003), over 19 environmental engineering companies and consultants have conducted some type of environmental assessment and/or corrective actions on the tracts of the subject area beginning in 1989, with work projected until at least 2007. Phase I, Phase II, and Ecological Risk Assessments have been conducted over the 18-year time frame. During this 18-year time frame, 148,160-acres of southern EAA land encompassing the state and federally owned lands and four state-constructed Everglades Construction Project STAs (consisting of over 30 individual tracts of land) were assessed for contamination. When evaluated as a whole unit, the Phase I and Phase II environmental site assessments (ESAs) provide a comprehensive overview of the properties, identify point sources including chemical storage and mixing areas, agrochemical and petroleum storage tanks, refueling and maintenance areas and residual agrochemicals and soil addenda in cultivated areas. Assessments have been conducted at point

source areas and, where present, impacted media abated. In 2003, the SFWMD reported there were 17 areas remaining that required closure, including three tracts that had not been evaluated. According to the SFWMD, the closure of the 17 areas and/or evaluations will be completed by 2007.

Evaluation of samples collected from the cultivated areas have identified localized areas of agrochemical (toxaphene) impacts at Tract No. 100-039—Woerner Farm #3, which was targeted for abatement and remediated. However, the clean-up effort failed to achieve the site specific clean-up goals for toxaphene. As a result of this finding, the Fish and Wildlife Service has recommended that, at a minimum, a more rigorous environmental risk assessment be conducted by the responsible party. In the event that additional clean-up sufficient to reduce toxaphene to levels not threatening to future fish and wildlife utilization is warranted, remediation would precede the operation of the reservoir in the contaminated zone. To date, with the exception of this one tract, elevated levels of persistent or toxic chemicals have not been detected, or only detected at low levels below thresholds of concern for ecological integrity.

Additional lands owned by either the State of Florida or the SFWMD, located between Compartment A and the Miami River Canal along the northern boundary of Holey Land make up three previously assessed tracts—Tract No. 100-103 Farm 15, Tract No. 100-018, and Tract No. 100-019, respectively. The URS summary document reported the environmental status of each tract as follows:

- Tract No. 100-103 Farm 15 was divided into three monitoring units—Pump Station, Equipment Staging Area, and Cultivated Crop Area. Only the Pump Station portion of the site required closure; the Equipment and Crop areas were determine by the USFWS and FDEP to require no further action (NFA).
- Tract No. 100-018 was designated as requiring no further action.
- Tract No. 100-019 was designated as requiring no further action

In addition to the above, several site visits were conducted at locations identified in the HTRW database over the past few years. The HTRW database review of existing conditions found the project site to be free of hazardous and toxic materials and waste. The property surrounding the potential project site did not have discolored soils or stressed vegetation, or any other indicator of contamination levels requiring cleanup. No hazardous substances in connection with identified uses were observed. However, the database search did reveal that a road adjacent to the original Restudy proposed 60,000-acre (24,281 ha) storage area did have a toxic release to the north of the northernmost 20,000-acre (8,094 ha) storage cell. This spill poses a low risk to the site.

Canals sediments in the primary canals--Miami, North New River, Cross, and Bolles--have been sampled and analyzed in conjunction with the SFWMD DBHYDRO database. Data indicates that sediments contain persistent pesticides--DDT and its degradation products most prevalent. The sum of DDT and DDT products in recent samples reaches one- to five-tenths of a milligram per kilogram of sediment [0.1 mg/kg (ppb)–0.5 mg/kg (ppb)] are shown in Table 2-5.

TABLE 2-5: SOIL CLEAN-UP TARGET LEVELS AND SQAGS (SEDIMENT QUALITY ASSESSMENT GOALS)

Parameter	Units	SQAG1		Soil Cleanup Target Levels2		Sample Analytical Result (Max.)
		TEL	PEL	Residential	Groundwater Leachability	
4, 4' - DDT	ug/kg	1.19	4.77	3300	11000	500

When these values are compared to action levels (Chapter 62-777, F.A.C), the comparison reveals that canal sediment samples will typically exceed the SQAGs but never exceed State of Florida clean-up targets. Given the present elevated chloro-pesticide levels, and the disposition of the media within which it is contained, no remediation of canal material is required. However, environmental protection measures shall be specified for the construction phase of the proposed project. These measures will consist of, but not be limited to, the use of turbidity curtains, settling basins, and the encasement of canal materials in the constructed levees, as appropriate.

2.21 TRANSPORTATION, UTILITIES AND PUBLIC INFRASTRUCTURE

Due to its primarily agricultural and rural nature, local public infrastructure in the EAA is very limited. The only public utilities that provide services in the EAA are operated by and generally limited to the city limits of the small cities of Belle Glade, South Bay and Pahokee on the south side of Lake Okeechobee.

The road network in the EAA is also limited and is a mix of municipal, county, state and federal roads, located primarily in the northern portion of the EAA. State Road (SR) 80 is a major east - west road that runs through this area between West Palm Beach and Ft. Myers. Located immediately east of the proposed EAA Reservoir project is US 27 (also known as SR 25). It is the only major north – south road in this area and runs parallel to the west side of the North New River Canal (also known as the L-18 / L-19 / L-20 canal) from the Dade – Broward county area north to South Bay and then west around the southern and western portions of Lake Okeechobee where it then heads north in the state. US 27 is a major north-south route in and out of south Florida for evacuation and commerce purposes. Most of the road network outside the

urbanized area and south of Lake Okeechobee is off the major state and federal roads and consists of local, unpaved farm roads.

FPL has several major transmission lines that are located in the northern, eastern and southern portions of the EAA, but none that are located immediately adjacent to or traverse the proposed EAA Reservoir. These transmission lines include the Corbett – Orange River 230 kV transmission line that runs through the northern portion of the EAA, approximately 3 miles north of the Cross and Bolles canals, between the West Palm Beach area and Ft. Myers; the Andytown – Corbett and Andytown – Martin 500 kV transmission lines that run immediately west of and parallel to the L-6 and L-7 levees and WCA Nos. 1 and 2A; the Levee – Midway 500 kV transmission line that runs one mile west of these two 500 kV transmission lines until it turns south and runs long the west side of the North New River Canal, US 27, and STA 3/4 (south of the proposed EAA Reservoirs); and the Andytown – Orange River 500 kV transmission line that runs along the south side of STA 3/4 and the Holey Land, north of the L-5 levee, the Palm Beach – Broward County line, and WCA No. 3 from US 27 west to Ft. Myers.

Bell South and four fiber optic communications companies (WilTel Communications, Epik Communications, Broadwing Communications, and Northstar Communications) have a major underground trunk route that runs along the west side of US 27 within the Florida Department of Transportation (FDOT) right-of-way for US 27. There are no cell towers in the immediate vicinity of the EAA Reservoir and canal enhancement projects.

Except for the major electrical transmission lines along the eastern, northern and southern portions of the EAA and the major fiber optic lines along US 27, most of the existing utilities within the EAA study area and the proposed EAA Reservoir and along the North New River, Miami, and Cross and Bolles canals are local distribution type facilities that provide service to existing land uses and/or previous property owners or land uses. Aerial telephone lines are typically co-located on the same poles with electrical distribution lines under a cooperative cost-share arrangement between FPL, Bell South and other telecommunications companies.

There is an existing FPL distribution line along the main east-west drainage canal that provides power to the on-site pump stations that serve the existing farming operations on the Compartment A lands (formerly known as the Talisman Lower Ranch) and previously provided power to the Talisman Sugar Mill that has since been removed. This distribution line will be removed as part of the construction of the EAA Reservoirs project. Other remaining distribution lines in the EAA Reservoirs area will also be removed once the project design

has been finalized and it has been determined if any of them need to remain on an interim basis for construction purposes.

In the area between the proposed EAA Reservoir and Lake Okeechobee where there are proposed canal conveyance improvements to the North New River Canal, there are a number of bridges with telephone and communications lines and, in some cases, water and sewer lines suspended from them. Most of these bridges will need to be replaced and the utilities will be relocated as part of the bridge construction projects. In the case of the proposed canal conveyance improvements to the Cross and Bolles canals, the need for relocations of existing utility facilities that cross or run parallel to the Cross and Bolles canals will depend on the final project design and the location of the additional right-of-way to be acquired to implement the improvements. This includes one FPL 138kV transmission line that crosses the Bolles Canal approximately 2 miles west of US 27.

There is also a Florida East Coast Railroad line that traverses the northern portion of the EAA and includes spurs that provides service to the major sugar mills in the area. They cross the Miami Canal in two locations, one approximately 2 miles north of the Bolles Canal (L-21) and one approximately 3 miles south of the Bolles Canal.

The following map, Figure 2-4, depicts the existing bridges, roads and structures within the EAA Storage Reservoir region.

On the follow map, most of the bridges shown are not FDOT bridges. Only three of the existing bridges shown are FDOT and will be affected by the project. Those three are: SR-80 and SR-827 bridges over North New River and the U.S. 27 Bridge over the Bolles Canal. One new bridge or culvert will be constructed on U.S. 27 at the location of S-609.

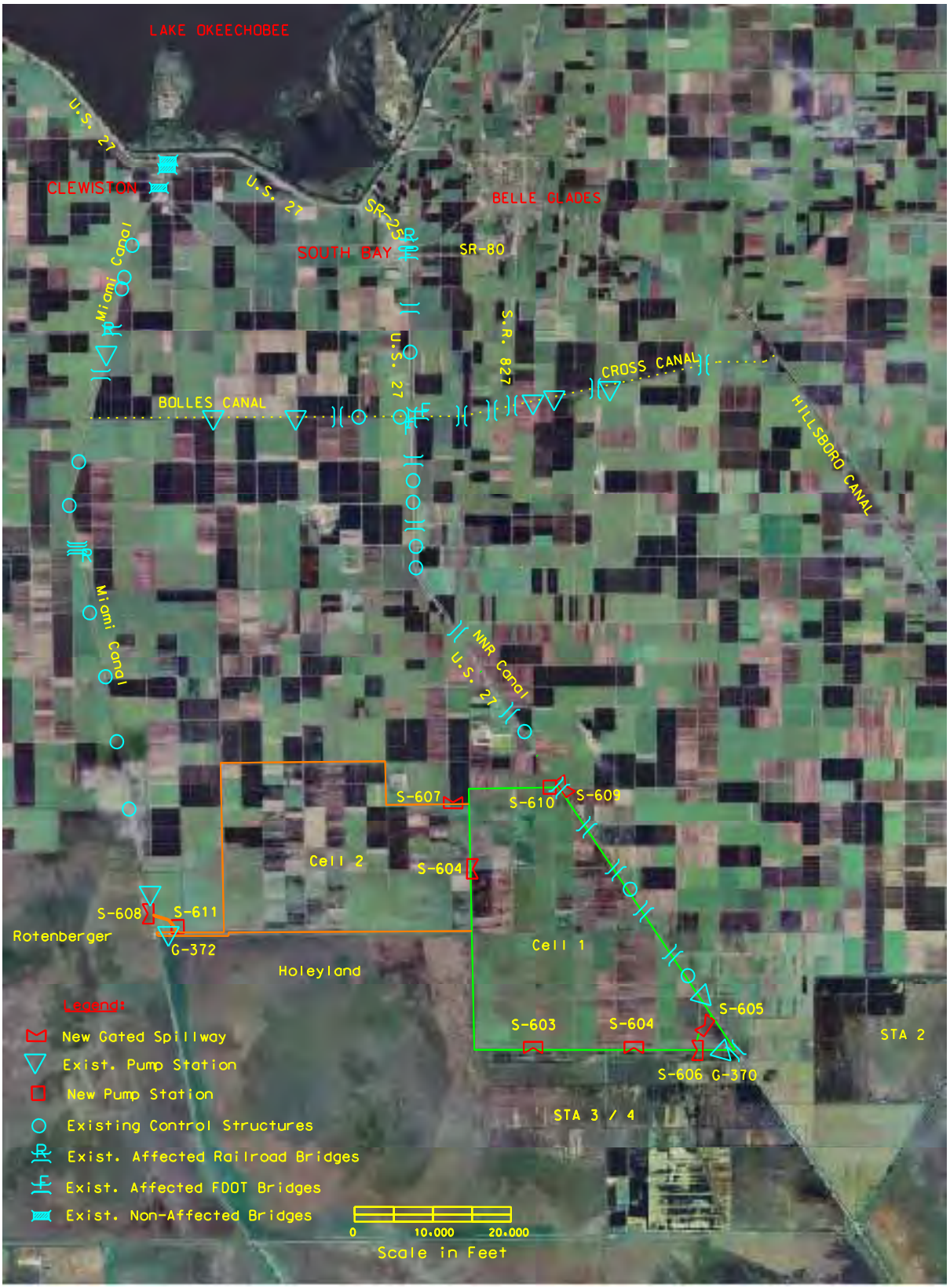

FIGURE 2-4: EXISTING BRIDGES, ROADS AND STRUCTURES WITHIN THE EAA STORAGE RESERVOIR REGION

SECTION 3
FUTURE WITHOUT PROJECT CONDITIONS

This page intentionally left blank

3.0 FUTURE WITHOUT PROJECT CONDITIONS

3.1 FORECAST OF FUTURE CONDITIONS

This section describes the most likely condition of the physical, biological, and human environments in the EAA and other affected areas in the year 2050 if the EAA Storage Reservoirs project is not constructed. The planning period from present-day through the year 2050 is used for analysis and forecasting the future "without project" and "with project" conditions, and for considering the impacts of alternative plans. It is the period of time necessary to analyze project/plan impacts.

The future without project condition describes what is assumed to be in place if none of a study's alternative plans are implemented. The without-project condition is the same as the "no action" alternative required by the Federal regulations implementing the National Environmental Policy Act of 1969 (NEPA). The future without condition forecast provides a description of anticipated actions external to the project and the anticipated consequences of these actions.

Future with project conditions describe the anticipated effects attributable to the implementation of each alternative plan that is being considered in this study. With project conditions are developed for each alternative plan; therefore, there are as many with project conditions, as there are alternative plans.

The differences between the "without project" condition and the "with project" condition are the effects or impacts of the plan.

In forecasting the future, consideration is given to discernable trends in conditions, impacts of known future projects and programs, and available forecasts of basic driving forces such as population growth.

Within the EAA, it is anticipated that Compartment A in the "without project" condition would remain in State ownership and would continue in agricultural and open space uses. Compartments B and C will be used in SFWMD's expansion of Everglades Construction Project STAs 2 and 5/6, respectively. In the larger Study Area, land use would not change dramatically from existing conditions. The areas around the Cities of Belle Glade, Pahokee, and South Bay would receive almost all the population growth while the remainder of the EAA would remain in agricultural and conservation uses through the year 2050.

As noted in the existing conditions, the organic soils of the EAA have been decomposing due to the introduction of oxygen into the upper layers. There is also direct loss of some soil with crops such as sod production. This subsidence of the land is a major trend that will control much of the future of the EAA. It is

projected that by 2050, about half the EAA would have soils less than 8-inches in depth. Most of these shallow soils would be south of the Bolles Canal. Without new production practices, sugarcane production would be difficult and costly. The area of these comparatively thin soils should be suitable for pasture, but not for vegetables. With reduced soil depth to store moisture, water control becomes crucial for any production of crops.

Whether or not there is extensive agricultural use of lands in the EAA from now until 2050 depends on many factors that are difficult to predict, such as commodity prices and governmental policies. The Comprehensive Plans of Palm Beach and Hendry Counties and the cities in the EAA will play key roles in determining future land use of the area. Palm Beach County, through its Future Land Use Plan and Managed Growth Tier System, appears committed to limiting westward expansion of the Urban/Suburban area. Large areas designated for Conservation west of the urbanized area would help achieve this goal.

The EAA would be affected by a variety of existing and proposed projects: SFWMD Long-term Plan, SFWMD Everglades Regulatory Program, and SFWMD Adaptive Implementation Strategy. Many of these projects are scheduled for completion before 2050. Most are associated with lowering total phosphorus (TP) concentrations entering the EPA. They will also affect other water quality parameters and the management of water in the EAA.

3.1.1 Geology, Topography, and Soils

Soil conditions in 2050 are expected to continue to subside in the EAA region, impacting agricultural productivity, costs, and water control. As soil subsides, a minor lowering of topography would be expected.

3.1.2 Flood Protection Level of Service

The EAA has very little natural drainage and depends on large pump stations to prevent floods from heavy rains. Pumps move excess water from the EAA to Lake Okeechobee or the Water Conservation Areas during wet months (Fernald and Patton, 1984). Construction of the EAA Reservoir Project will remove 31,000 acres of land from the drainage system providing incidental flood control improvement.

Lake Okeechobee should remain the primary reservoir of the C&SF Project through 2050 with or without the EAA Storage Reservoirs project (the "without project" condition). A series of structures situated around the lake in the EAA provide flood protection, control drainage, and facilitate navigation. USACE could continue operating the primary structures and navigation locks through 2050 and maintain the regulation schedule. SFWMD would continue to operate

and maintain the secondary water control structures and pump stations (Fernald and Patton, 1984).

Water levels in the lake should continue to be managed through 2050 according to a regulation schedule that is jointly developed by the SFWMD and USACE. The schedule would likely be modified as other CERP projects are completed. The present schedule is designed to maintain a minimum level during the wet season in order to provide storage capacity for excessive amounts of rainfall and to prevent flooding in surrounding areas. With completion of above ground reservoirs and STAs in the Lake Okeechobee watershed and the proposed C-43 basin between the present and 2050, it is reasonable to expect that both this low level and the maximum stage at the end of the wet season would be reduced accordingly. Through 2050, the Caloosahatchee and St. Lucie Rivers should remain the primary outlets for release of flood waters when the Lake is above regulation schedule stages.

3.1.3 Climate

The observed trend for global warming is expected to continue, but with little effect in the EAA. The attendant 0.8-foot rise in sea level is not expected to influence the project site, given its interior location, and would not affect plan selection. The final array of plans all consists of 360,000 acre-feet reservoirs in various configurations. The local climate of the EAA should not change from the present to 2050.

3.1.4 Air Quality

Air quality between the present and 2050 should not change significantly from existing conditions.

3.1.5 Noise

As additional areas are developed within designated growth boundaries around cities, noise from general traffic, construction, and other vehicles would be expected to increase modestly between the present and 2050.

3.1.6 Vegetation and Cover Types

3.1.6.1 Lake Okeechobee

Without the EAA Storage Reservoirs project, there would be continued use of Lake Okeechobee to store water for agricultural and flood control needs. High water levels in the lake would continue to adversely affect shallow littoral zone habitat, and deeper littoral zones would remain without vegetation in 2050. In

addition, the continued storage of nutrient-rich waters would maintain reduced water clarity that in turn adversely affects SAV areas.

3.1.6.2 Northern Estuaries

Between now and 2050, continued regulatory releases from Lake Okeechobee to the Caloosahatchee and St. Lucie River watersheds would further exacerbate stormwater impacts to the estuaries by releases of freshwater impulses. During the wet season, large pulses of freshwater should decrease salinity, increase nutrient inflow and increase turbidity to the estuary, thereby adversely affecting seagrasses.

3.1.6.3 Everglades Agricultural Area

Without the EAA Storage Reservoirs project, vegetation communities similar to those described in the Existing Conditions section would continue to exist in Compartment A and the entire EAA between now and 2050. Future environmental conditions in the EAA without the Project should be influenced by regional trends of soil subsidence and improving surface water quality. Of the two trends, soil subsidence should have a greater effect on the plant communities of the region. During the planning period, continued long-term physical changes in the soil of the region would result in some shifts in land use and vegetation cover, primarily in the most abundant land cover category-disturbed agricultural lands. It would also affect remnant upland and wetland communities within the region. Changes expected within the EAA include continued loss of topsoil over time with current soil loss estimated at 0.6 inches per year (Snyder, 2004). This rate of soil loss should continue, although some evidence suggests that as soils become more mineralized, oxidation of the soil and consequently, subsidence, will decrease. Regardless, changes in land cover should occur as a result of soil subsidence within the project planning period. In general, agriculture soils in the EAA evolve through a progression of agricultural uses depending upon amount of topsoil available. It should be noted that this discussion is related to generalized trends on how subsidence affects land cover, without consideration of the important forces of politics and economics on agriculture.

Historically, vegetables were the primary crop in the upper Everglades from the 1930s through the 1940s which required deeper soils and good water control. As soil subsidence continued, sugarcane emerged as the primary crop due to its ability to tolerate wetter, shallower soils. Wetter soils result from the reduced ability to effectively drain shallow soils and the lowered land surface elevation due to subsidence. As the soil layer diminishes over the bedrock, agricultural products tolerant of wetter conditions such as rice or some pasture grasses are favored and replace sugarcane. However, continued changes in agricultural practices and/or cultivars may extend the time period for practical use of some

crops, so the ability to predict the land use and cover in the EAA over the next 50 to 60 years is imprecise.

Geographic differences exist in the depth of soils within the EAA. Thicker soils are more prevalent in the north near Lake Okeechobee and thinner soils more common to the south. This suggests that changes within the EAA over the next 60 years would occur in the southern portions of the EAA and move northward.

Changes to the remnant "natural" communities on lands within the EAA are dependent upon the overall agricultural use of the region and resultant water management. Water management of the STAs and WMAs would continue with little changes in vegetation cover anticipated in these areas. With continued use of the EAA region for agriculture through the year 2050, no significant net increase or decrease in aquatic areas within the EAA should occur without the Project. For remnant wetlands, continued subsidence of lands surrounding existing, small, isolated wetlands could slightly increase the extent of wetlands into formerly cultivated lands. Larger scale changes in wetland cover could occur in some areas if agriculture is abandoned in some portions of the EAA. Cessation of active drainage of the agricultural fields by pumping, would likely cause the fallow lands to revert to wetlands. Similarly, upland community margins could change to transitional wetlands, if the surrounding landscape becomes wetter, slightly, but not significantly reducing upland communities.

Predictions for disturbed land covers (which include all agricultural lands) through the year 2050 are that no net increase or decrease in disturbed area would occur, but shifts between specific agricultural cover types could occur. About half the EAA could remain suitable for present day crops and the remainder could shift to more water tolerant crops (Snyder, 2004).

For urban and extractive cover types, there should be an increase in the urban area around the existing population centers of Pahokee, Belle Glade, and South Bay. By 2050, there should not be an additional increase or decrease in extractive land cover in the EAA.

Without development of a water storage reservoir, Compartment A would remain as disturbed land (agricultural), although some crop changes could result over time as soil thickness decreases. These changes would likely result in a conversion of vegetable crops to sugarcane, and some conversion of wetter sugarcane land to other wet tolerant crops such as rice or wetter pasture grasses. Therefore, existing vegetation communities generally represent future conditions within Compartment A with some shift to crops tolerant of wetter conditions and minor shifts in remnant natural communities to those tolerant of increased water inundation. All or part of Compartments B and C will be converted to STAs, which would result in submergent and emergent vegetation.

3.1.6.4 Water Conservation Areas

Without reservoir storage capacity, water released to the WCAs could continue to be difficult to manage. The WCAs need water to sustain ecological needs during the dry season and protection from large freshwater releases related to flood control during the wet season. Continuation of the altered hydroperiods within the WCAs could have adverse effects on marsh communities and tree islands.

3.1.7 Fish and Wildlife

3.1.7.1 Lake Okeechobee

The desired restoration of historic water fluctuations within Lake Okeechobee could not be accomplished by 2050 without the Project. Although recent modifications to the lake's regulation schedule will assist in the restoration of Lake Okeechobee, the full benefit would not be fully realized without the available storage of the EAA reservoir. Continued artificially high water levels within the Lake Okeechobee basin reduces the availability of bedding habitat for fishes, and changes the extent and composition of the emergent and submergent vegetation communities. If opportunities for lower water levels were allowed, this would provide good foraging for wading birds and other birds dependent upon aquatic prey species by concentrating prey and exposing additional shallow water habitat.

3.1.7.2 Northern Estuaries

Continued regulatory releases from Lake Okeechobee would adversely affect the estuarine water quality and the plants and animals within the estuary. Reduction of health or extent of the SAV has deleterious impacts to the estuarine fish and invertebrates that utilize this habitat as a nursery area. Loss of juvenile fish and shellfish as prey for predatory fish and birds has a cumulative adverse impact through the estuarine and marine food web, as well as directly reducing commercially important fish and shellfish.

3.1.7.3 Everglades Agricultural Area

Without the Project, no significant change would likely result to fish and wildlife populations in Compartment A. Regional trends that could shape future conditions in Compartment A as well as the whole EAA, through the planning period include: 1) minor changes in land cover/use caused by wetter conditions from soil subsidence; and, 2) improved surface water quality. Minor changes in regional land cover were discussed previously. In general, shifts to somewhat wetter conditions in the EAA would favor wetland fauna or wetland dependent

fauna tolerant of the disturbed conditions in agricultural production areas. Some displacement of wildlife could result from expansion of urban or extractive land cover types within the EAA; however, these changes are not likely to affect Compartment A.

Regional trends in water quality within the EAA should affect fish, aquatic or wetland wildlife populations directly or indirectly by affecting prey or forage used by wetland dependent species. Nutrient loadings to surface water would generally decrease through the project planning period. Slight declines in turbidity and suspended solids, sulfate concentrations, pesticides, and specific conductance in canals should continue. Thus, through the year 2050 under "without project" conditions, water quality should continue to generally improve. This will improve fish populations by increasing water clarity and allowing increased coverage of important fish habitat such as SAV. The general improvement of water quality within canals should somewhat benefit resident fish or wildlife directly; however, downstream receiving waters and fauna would significantly benefit. Although the canals contribute to significant amounts of open water areas in the EAA and Compartment A, they have low habitat value due to their construction and management. These can lessen potential benefits to resident wildlife compared to more natural shallow, open water habitat. Canals generally lack littoral zones due to steeply sloped sides. These canals have reduced emergent or submergent vegetation due to vegetation management used to maintain conveyance capacities and levee integrity. Consequently, without the Project, wetlands, particularly marshes, should benefit by nutrient reductions since cattail-dominated freshwater marshes arise in nutrient-rich conditions, whereas sawgrass is favored in nutrient-poor conditions.

3.1.7.4 Water Conservation Areas

Both water supply and water quality affect fish and wildlife in the WCAs. From a quantity, timing, and distribution standpoint, the future-without-project condition may further degrade or improve slightly. The current system does not allow water managers the flexibility of providing water to the WCAs during the dry season for ecological needs. This increases the susceptibility of these area to large freshwater releases related to flood control. Continuation of altered hydroperiods within the WCAs could have adverse effects on marsh communities and tree islands as well as the wildlife that depend on them.

Current trends in water quality within the WCAs impact fish, aquatic or wetland wildlife populations directly and indirectly by affecting prey or forage used by wetland dependent species. Stormwater Treatment Areas built as part of the Everglades Construction Project are expected to improve the quality of water going into the WCAs. Nutrient loadings to surface water will decrease through the project planning period. Thus, through the year 2050 under

"without project" conditions, water quality should continue to improve. This could improve fish populations by increasing water clarity and allowing increased coverage of important fish habitat.

3.1.8 Federally-listed Threatened and Endangered Species

Without the Project, use of the EAA and Compartment A by most endangered, threatened, or state-listed wildlife should not change during the planning period through 2050. Exceptions may include the federally endangered West Indian manatee, the threatened crested caracara and the Florida burrowing owl, a state-listed species of special concern. Studies are currently underway to document use of the canals by manatees. A preliminary map has been produced that shows over half the canals within the EAA are accessible to manatees. Maintenance dredging or other construction/repair activities may create obstruction for manatees. Manatees within the canals may continue to become entrapped within the system and suffer harm or mortality due to poor quality habitat and inability to navigate to more suitable habitat.

Other federally-listed species occurring in the EAA include the crested caracara, which is known to use Compartment A. Caracara use a variety of open habitat, both upland and wetland, for foraging. Maintenance of an open agricultural and wetland mix in Compartment A under the "without project" condition would continue to provide habitat for the caracara.

Water quality improvements in the WCAs would benefit the wood stork, snail kite, and bald eagle by increasing the available forage, improving access to prey species and reducing possible exposure to contaminants including pesticides. Somewhat improved water clarity and reduced nutrients improve habitat for the apple snail and increase successful foraging by the Everglades snail kite. However, the limited number of shallow open water or marsh communities in the EAA would minimize benefits of improved water quality to snail kite populations.

The without project condition could contribute to the decline of the Okeechobee gourd which is typically found around Lake Okeechobee. Water management practices in the future could contribute to promoting nuisance / exotic vegetation around Lake Okeechobee, which could out-compete the gourd.

Other federally-listed species that would be unaffected by the "without project" condition include the Florida panther, Eastern indigo snake, and the Okeechobee gourd. No changes to limited Florida panther use of the EAA would likely result from the "without project" condition. The eastern indigo snake may continue to use some marginal habitat on Compartment A.

In the estuarine areas of the St. Lucie and Caloosahatchee watersheds, continued pulse releases of freshwater from Lake Okeechobee would further degrade the water quality of the estuaries and continue the high fluctuations in salinity. This would have a continued adverse affect on Johnson's sea grass, and it is possible that the spatial extent of this seagrass would continue to decline. Loss of additional SAV could affect federally listed species such as sea turtles and manatees by reducing available grazing areas. The loss of suitable habitat for smaller fishes and further decline of water quality would also likely have an adverse effect on the smalltooth sawfish. Smalltooth sawfish may be especially vulnerable to coastal habitat degradation due to their affinity to shallow, estuarine systems. Because of the slow individual growth, late maturation, and low fecundity, long-term commitments to habitat protection are necessary for the eventual recovery of the species (NMFS, 2000).

3.1.9 State-listed species

The Florida burrowing owl was documented in Compartment A. If the owls are resident to the area and have burrows within Compartment A, burrowing owl use without the Project could continue until soil subsidence and wetness make it unacceptable for burrow construction and maintenance. This species generally uses open upland habitat such as dry prairie or pastures.

Regional environmental trends in the EAA that would continue with or without the Project, include soil subsidence and gradually increasing soil wetness. As subsidence continues, slight expansion of wetland habitat may slightly benefit some wetland dependent species. Region-wide improvements of water quality would generally benefit state-listed wading birds (little blue heron, tri-colored heron, snowy egret, reddish egret, white ibis, limpkin, and roseate spoonbill).

Continued adverse affects on listed wading birds could result from the "without project" condition in both Lake Okeechobee and the WCA since regulation of surface water levels may compromise ecological needs for flood control needs.

3.1.10 Water Management

The land use of the area should remain primarily agriculture with a growth in urban areas, primarily at the expense of pasture through 2050. EAA agricultural activities, and to a certain extent, areas along the Caloosahatchee and St. Lucie Rivers, utilize canals and culverts associated with Lake Okeechobee as a source of irrigation water. Although the current configuration of the lake was designed primarily to provide drainage, flood control and water supply benefits, the single largest demand on Lake Okeechobee today and through 2050 is to provide water for agricultural irrigation.

Future water management without the Project should be subject to minimal changes through 2050.

3.1.11 Water Quality

Many other projects scheduled for completion within the planning period have the specific purpose of lowering total phosphorus (TP) concentrations entering the EPA and will also affect a variety of other water quality parameters. Some of the projects will not show effects in the near future. For example, the overall goal of the Lake Okeechobee Protection Plan is to reduce TP loading from the watershed to the lake to an average of 140 metric tons per year from all sources. The Lake Okeechobee Priority basins contribute an approximate average annual P loading to the lake of 322 metric tons, which is over 60% of the total P load (515 metric tons/yr) currently entering Lake Okeechobee. Assuming a 25% BMP reduction and a P-load TMDL of approximately 80 metric tons/year (approx. half of the total TMDL for the north rim of Lake Okeechobee, only) this leaves another approximate 102 metric tons/yr (or, so) of P load from the southern Lake Okeechobee basins that must be removed in order to achieve the overall Lake TMDL goal. This load is expected to eventually result in lower average in-lake TP concentration. However, this improvement is not expected to be achievable for at least 30 years following the mandated 2015 project completion date. This gradual reduction of TP concentration in the lake water column is expected due to the phosphorus trapped in sediments that will be released for years after TP levels in the water have dropped (FDEP, 2001).

Several other basins and watersheds are being incorporated into the EAA through the STAs. Although not directly a part of the EAA, water quality improvements in contributing basins would affect interior water quality, especially in the STAs.

Total phosphorus is a parameter of particular concern in the EAA. Currently, implemented BMPs in the EAA have resulted in reductions of TP meeting or exceeding the 25 % reduction required for compliance (McGinnes, et al., 2004). In addition, the STAs have performed better than predicted and are planned to be further enhanced until completion in 2006 (B&M, 2003; Piccone, et al., 2004).

Additional projects that could improve water quality parameters are the improved operation of Holey Land and Rotenberger WMAs, which could increase nutrient removal efficiencies in these natural wetland areas through better hydroperiod management. Also, any conversion of EAA lands from sugarcane farming to fallow lands (possibly natural wetlands) would further reduce TP loads downstream.

Assuming the successful implementation of all of these projects there would be a continuing decline of TP concentrations within the surface waters of the EAA. Several other water quality parameters could be expected to change in response to anticipated activities and land use changes in the EAA over the planning period. For example, concentrations of organic nitrogen could decrease in response to the water quality programs being implemented in Lake Okeechobee, in the contributing basins to the EAA, and within the EAA. Total nitrogen concentrations have been declining in the EAA canals since at least the 1970s, apparently in response to changing farming practices and BMPs. These nitrogen concentrations should eventually level off at approximately 2 to 2.2 milligrams per liter (mg/L) based on normal background concentrations typical of South Florida wetlands.

Dissolved oxygen (DO) concentrations in the EAA canals have averaged between 3.9 and 4.8 mg/L over the past four decades with no clear temporal trends. These concentrations could increase slightly as a result of decreased nutrients in Lake Okeechobee. The water in the canals is largely from the lake. Lower nutrients in the lake will result in reduced levels of algae. This in turn would reduce the organic load to the canals allowing dissolved oxygen levels to rise slightly in the future. However, due to the physical nature of the canals and their position in an area of wetlands and organic soils, DO concentrations should continue to be depressed below the 5 mg/L Class III water quality criterion. DO concentrations within the STAs and within natural wetlands in the Holey Land and Rotenberger WMAs should remain similar to current conditions (typically < 4 mg/L).

Specific conductance increased in the EAA canals until the 1980s to an average of about 1,028 microSiemens per centimeter (µS/cm) and has been decreasing since that time. This decreasing specific conductance trend should continue in light of changing agricultural practices in the EAA to near historic levels, approximately 600 µS/cm, by the end of the planning period.

Levels of turbidity and suspended solids have declined slightly in the EAA canals in the past decade. A continuing trend of decreasing concentrations is expected in light of the variety of water quality improvement projects in and around the EAA. This trend could result in EAA canal concentrations of turbidity and suspended solids less than 10 Nephelometric Turbidity Units (NTU) and 10 mg/L, respectively.

Sulfate concentrations in the EAA canals increased from the earliest records in the 1930s through the 1980s when they reached a maximum decade average concentration of about 97 mg/L. Since 2000, average canal sulfate concentrations have declined to 1930s levels (about 42 mg/L). Total mercury

concentrations have also decreased in the EAA canals over the past decade. This trend should continue under the "without project" condition.

Concentrations of some key pesticides that are frequently found in the EAA canals have declined precipitously over the past three decades. For example, average canal water concentrations for atrazine have declined from 1.2 to 0.6 µg/L since the 1980s. The average simazine concentration has declined from 2.2 to 0.08 µg/L over the same period. This trend should continue through 2050.

3.1.12 Sediment Quality

The flat terrain of the EAA limits the movement of water through the canals. Generally, water movement occurs only when water is pumped. As a result, there is little erosion and deposition of sediments in the canals and little maintenance dredging of the canals. Thus, during the planning period through 2050, the sediments should show little change from existing conditions in the "without project" condition.

3.1.13 Socioeconomics

In general, South Florida should continue strong economic and population growth through 2050. The areas on the east coast of Martin and St. Lucie Counties and west coast of Lee County should participate in this growth. Other localities in the area of interest would not share in this overall trend. The important features of the economic landscape are agricultural activity, fishing, tourism, and recreation and should continue to be the case for 2050.

The Caloosahatchee River region is one of the fastest growing areas in the nation. The population is expected to increase 63% by 2015. Then the growth rate should level off to achieve an additional 36% by 2050. Population in Martin and St. Lucie Counties should double by 2050.

Despite population loss in the EAA between 1990 and 2000, the area should see significant population growth in the planning period. Palm Beach County's population is projected to increase 64%, from 1.13 million to 1.86 million, over the thirty year period from 2000 to 2030 (BEBR, 2002). Assuming a conservative 1% annual growth rate between 2030 and 2050, Palm Beach County's population would grow to 2.27 million. Hendry County has a much smaller population but should grow 71%, from 36,000 to 62,000 between 2000 and 2030. Assuming the same 1% annual growth rate from 2030 to 2050, Hendry County's population would grow to 75,000 persons.

Compartment A under the "without project" condition would not have significant direct or indirect effects on population within the EAA or the South Florida Region as measured by displaced population from Compartment A and induced

population growth. The 2000 U.S. Census reported 20 persons living along the eastern border of Compartment A. The purchase agreement between the United States Department of Interior (DOI), SFWMD and the landowners allowed farming to continue on most of the land until March 31, 2005. After March 2005, land could be leased for agricultural purposes until needed by USACE for restoration purposes.

Under the "without project" condition, likely land uses in Compartment A would not have a significant effect on future population growth in other areas resulting from agricultural uses of the area or conversion to open space uses. Palm Beach County's "Agriculture Production" land use designation on Compartment A restricts residential development to farm labor quarters and camps, caretaker's quarters (e.g., for pump houses), and dwelling quarters and farm residences for bona fide farm operations. Consequently, future residential development potential on the property is limited by the land use designation, whether the property remains in agricultural uses or is converted to open space. Even in the unlikely event that the land use designation was changed to allow higher density residential development, lack of central water and sewer infrastructure effectively preclude most residential development.

3.1.14 Land Use

Palm Beach County's Managed Growth Tier System (MGTS), adopted in 1999, designates all land in the EAA as Glades Rural Tier, Urban Glades Tier, or Conservation. Glades Rural Tier was established to protect valuable agriculture areas and has only limited residential development potential. The Urban Glades Tier encompasses 26,532 acres and is comprised of the Cities of Belle Glade, Pahokee, South Bay, and an Urban Services Area surrounding the three areas.

Within the Palm Beach County portion of the EAA, new growth will be channeled to the Urban Glades Tier, which contains a significant percentage of the county's remaining undeveloped land with urban residential development potential. Within the Glades Rural Tier, maximum residential densities of one dwelling unit per 10 acres may be allowed. Similarly, in Hendry County, growth will be directed to near Lake Okeechobee with areas to the south designated for agricultural land uses.

Land use changes should influence future water quality conditions. It has been estimated that due to oxidation and subsidence of organic soils (Histosols) and based on standard farming practices, about 62,000 acres of the 570,000 acres of arable land would be unusable for any current agricultural use by 2050 (Snyder, 2004). An additional 241,000 acres would only be useable for highly water tolerant crops within that same period. Smaller acreages could be lost to farming if soils conserving farming practices are implemented in the near future.

For the purposes of this forecast, it is assumed that areas of the EAA lost to farming would be converted to relatively natural wetland areas. Other land use changes should be relatively minor in the EAA. No significant urban or commercial development should occur except for the urban service areas of Belle Glade, Pahokee, and South Bay during the project planning period.

Along the west coast of Lee County and the east coasts of Martin and St. Lucie Counties, a significant expansion of urban area should occur by 2050.

Under the "without project" condition, land use on Compartment A would be either open space or agriculture. There would be no significant direct effects on land use from the "without project" condition.

3.1.15 Recreational Resources

Between the present and 2050, recreational resources within the area and the EAA should not change significantly under the "without project" condition. Recreation on Compartment A in the "without project" condition would include hunting, fishing, nature study, and hiking.

3.1.16 Aesthetics

Under the "without project" condition, little change in the landscape is expected between the present and 2050. The visual environment should remain as described in the existing conditions.

3.1.17 Cultural Resources

Land use in Compartment A and canals are not anticipated to change. Therefore, no impacts anticipate.

3.1.18 Hazardous, Toxic, and Radioactive Waste

Under the "without project" condition, much of the EAA should remain in agriculture or open space uses. With agricultural land use, could be the potential of additional toxic releases between the present and 2050. This potential exists because of the use of fuel and agricultural chemicals on the lands and roads of the EAA and on Compartment A.

3.1.19 Transportation, utilities and public Infrastructure

Utilities and infrastructure are not anticipated to change significantly in the future without condition, as the project area would remain agricultural or revert to natural wetlands. Transportation corridors, such as US 27, are anticipated to

expand in future development plans. The future without condition for transportation and association structures for future roadway development would follow the Department of Transportation's plans. Details of future expansions will be provided in the Final PIR.

This page intentionally left blank

SECTION 4
IDENTIFICATION OF PROBLEMS AND OPPORTUNITIES

This page intentionally left blank

4.0 IDENTIFICATION OF PROBLEMS AND OPPORTUNITIES

4.1 STATEMENT OF PROBLEMS AND OPPORTUNITIES

Water resources projects are planned and implemented to solve problems, meet challenges, and seize opportunities. A problem can be thought of as an undesirable condition, while an opportunity offers a chance for progress or improvement. The identification of problems and opportunities focuses the planning effort and aids in the development of objectives. Problems and opportunities can also be viewed as local and regional resource conditions that can be modified in response to expressed public concerns. This section identifies the concerns and needs of the affected public and describes problems the EAA Storage Reservoir project is attempting to resolve, as well as opportunities to benefit the natural and human environment.

The Study Area encompasses the Lake Okeechobee Service Areas, which includes agricultural, Tribal, and municipal water users in the local basins within the Lake Okeechobee watershed and the Everglades Agricultural Area. Water from the lake also serves as a backup source of water supply for the heavily populated and growing areas of the lower East Coast of Florida. Current operations for the C&SF Project involve water supply and flood releases to manage water levels in Lake Okeechobee, the WCAs, and the East Everglades. System changes have resulted in peak flows that are higher, following major rain events, and flow rates that decline more abruptly following the end of the wet season. Flows to the Everglades from Lake Okeechobee have shifted from primarily wet season flows in response to rainfall, to controlled dry season deliveries in response to urban and agricultural water demands. Channelization and impoundment have disrupted the annual pattern of rising and falling water depths in the remaining wetlands of South Florida.

Lake management practices result in higher than desirable lake levels associated with periodic large freshwater discharges to both the Caloosahatchee and St. Lucie River Estuaries, which has severely disrupted productivity in the ecological communities in those estuaries. The high lake levels also damage the ecological communities within the lake's littoral zone. Environmentalists and scientists within the environmental community endorse lowering lake levels while recognizing the need to maintain existing levels of water supply for agricultural and public purposes. These issues highlight the balance that the CERP, and the EAA Storage Reservoir project as an integral part of the CERP, must achieve to be successful.

4.1.1 Public Input in Developing Statement of Problems and Opportunities

NEPA requires full public participation in the planning and decision-making process. As such, a Public Involvement Program was established for this Project

(please refer to the Appendices for additional detail). Four distinct initiatives were undertaken to garner public input:

- Establishment of a website (www.evergladesplan.org) to provide information and communication paths.
- Submission of scoping letter to identified Project stakeholders providing a description of the EAA Storage Reservoir project and identifying points of contact for more information or registering concerns.
- Two public workshops were conducted in Spanish and English at Belle Glade in August 2001 and January 2003.
- A series of PDT meetings (that were open to the public) were held within 50 miles of the Study Area.

Many of the issues identified through this process are related to the conflict between encroaching human development and the natural environment. Public comments generally supported the Project's goals and objectives, but expressed concern over the length of the Project schedule. There was skepticism regarding the cost-effectiveness of storage reservoirs versus storing water in Lake Okeechobee or the WCAs due to increased evaporation and seepage from the reservoirs. Suggestions were put forth by the public to investigate alternate approaches to restoring historic flows and flow-ways. Many of the public comments were concerns regarding potential impact to jobs in the Study Area.

4.1.2 Water Quality

4.1.2.1 Everglades and WCAs

The conversion of historic wetlands south of Lake Okeechobee into agricultural land with its attendant water management practices has altered the frequency, duration, and magnitude of interannual wet and dry cycles, and introduced high nutrient loading into portions of the regional water management system. Runoff from the EAA contains significant quantities of nutrients. Those nutrients most notably recognized include phosphorous derived from agricultural practices. The hydrology and vegetative communities of the remaining Everglades have become altered by the operations of the C&SF Project and the discharge of high levels of water-borne nutrients. The resulting loss in spatial extent increased concentrations of pollutants in remaining natural system surface waters, sediments, and wetlands.

4.1.2.2 Lake Okeechobee

High levels of nutrients and other pollutants enter Lake Okeechobee from tributary basins north, east, and west of the lake and are back-pumped to Lake Okeechobee from the EAA. The discharge of nutrients has contributed to the

eutrophic state of the lake, although it should be noted that the EAA is not the largest source of nutrients entering Lake Okeechobee. There are other larger sources of nutrients to the lake, notably the Kissimmee River basin and the Taylor Creek/Nubbin Slough Basin. Lake Okeechobee is designated as a Class I water body according to the Florida Administrative Code (FAC). This means that it is used as a potable water supply source. However, in a recent listing of water body sites where water quality was not adequate to sustain its designated uses prepared by FDEP, Lake Okeechobee had several monitoring stations where excessive nutrients, low levels of dissolved oxygen and high concentrations of unionized ammonia, iron, chlorides and coliform bacteria were found. Several ongoing restoration efforts, coupled with recently implemented best management practices have resulted in improved water quality for the lake; however, water quality remains a problem. FDEP has recently adopted a total maximum daily load (TMDL) of 140 metric tons (tonnes) of phosphorus for all sources to Lake Okeechobee.

4.1.2.3 Northern Estuaries

Periodic releases of large amounts of freshwater from Lake Okeechobee via the C-44 Canal to the St. Lucie River and Estuary and southern Indian River Lagoon and via the C-43 Canal to the Caloosahatchee River and Estuary have had extremely destructive effects upon the ecological communities in these receiving water bodies. These releases deliver turbidity, sediments and nutrients to the estuaries. They also alter the salinity levels in these estuaries.

4.1.2.4 Opportunities

The EAA Storage Reservoir project represents an opportunity to improve the environment and assist in the restoration of the Everglades ecosystem. Currently, periodic regulatory releases from Lake Okeechobee to prevent flooding damage the northern estuaries. In addition, much of the supplemental water supply needed during the dry season by the EAA is met by deliveries from Lake Okeechobee. Additional water storage in the EAA will reduce the impact of harmful discharges of fresh water to the estuaries and lessen the dependency of agricultural water users in the basin on Lake Okeechobee releases for irrigation water. This will reduce agricultural water supply demands on the lake and allow it to be operated to provide additional supplemental environmental deliveries of water to the Water Conservation Areas and Everglades National Park and to meet other water related needs, including water supply and resource protection.

Properly sized and designed storage areas have the potential of improving the quality of water being delivered to the natural system. This improvement is achieved by a reduction in Lake Okeechobee regulatory releases to the estuaries, reduction in Lake Okeechobee backpumping and balancing the timing and

distribution of flow to the STA's. Nutrient removal by biological and physical means could occur within the storage reservoirs through uptake by plants and microorganisms, as well as by physically slowing water and causing sediments laden with nutrients and agricultural chemicals to settle out of the water column. During certain hydrologic conditions, operation of a storage reservoir may require additional water quality treatment capacity to meet desired water quality goals in the WCAs. An evaluation of the need for supplemental STA treatment capacity will be completed during the project detailed design phase.

4.1.3 Environmental Resources

4.1.3.1 Everglades and WCAs

The predrainage landscapes of the EAA and WCAs consisted of complex mosaics of habitat types interspersed variously on the flat peat bed that had accumulated over the past 5,000 years. These habitat types and the associated peat developed in response to the expansive sheet flows of water from Lake Okeechobee, the seasonality of rain, and fire. The remnants of this vast complex of vegetative and aquatic communities can be found in the tree islands, sawgrass strands, wet prairies, and aquatic sloughs in the ENP.

Construction and operation of the C&SF Project and its subsequent modification of the natural system have contributed to the reduction in spatial extent and resiliency of the Everglades. Current operations of the C&SF Project involve water supply and flood releases to manage stage levels in Lake Okeechobee, the WCAs, and the East Everglades. System changes have resulted in peak flows that are higher, following major rain events, and flow rates that decline more abruptly following the end of the wet season. Flows to the Everglades from Lake Okeechobee have shifted from primarily wet season flows in response to rainfall to controlled dry season deliveries in response to urban and agricultural water demands. Channelization and impoundment have disrupted the annual pattern of rising and falling water depths in the remaining wetlands of South Florida. The network of C&SF Project canals has accelerated the spread of polluted water, sediments, and exotic species. These cause reduced system-wide levels of primary and secondary production and changes in the proportions of community types within the remaining Everglades system. The result is reduced water storage capacity in the remaining natural system and an unnatural mosaic of impounded, fragmented, over-inundated, and over-drained marshes.

Specific water management issues and problems differ within each WCA. Generally, the extreme wet-dry cycle and increased nutrient levels within WCAs have resulted in the loss of tree island communities and conversion of once wet prairies into aquatic sloughs.

4.1.3.2 Lake Okeechobee

Ecosystem damage in the Lake Okeechobee littoral zone includes the loss of beneficial plant life as well as continued growth and colonization by melaleuca, torpedo grass, and other exotic plants. Prolonged high water levels stress native vegetation. This stressed native community provides an opportunity for exotic species to invade areas previously occupied by native species. These exotics are able to aggressively and successfully compete with native species.

4.1.3.3 Northern Estuaries

Releases from Lake Okeechobee to the C-44 and C-43 canals inject large amounts of freshwater and pollutants into the St. Lucie River and Estuary, southern Indian River Lagoon, and the Caloosahatchee River and Estuary. Seagrass beds in these estuaries are stressed, reduced, and eliminated by salinity fluctuations, turbidity, sedimentation, nutrient enrichment, and algal blooms. Oysters have also largely been eliminated from the estuaries because of the freshwater pulses and lack of substrate. Submerged aquatic vegetation and oyster reefs are important habitats for fish and other organisms.

4.1.3.4 Opportunities

The EAA Storage Reservoir project, if properly designed, is an opportunity to improve water deliveries to the WCAs (via the existing STAs) and incrementally improve the ecological communities in the WCAs, Everglades National Park, Lake Okeechobee, and the two estuaries. This is accomplished by storing regulatory releases from Lake Okeechobee to the northern estuaries, eliminating backpumping of water from the EAA to the lake, providing an additional increment of storage volume to allow lowering of Lake Okeechobee water levels, and providing an additional source of water to meet environmental targets in the WCAs and Everglades National Park.

During the wet season, storage within the EAA will help reduce ecologically damaging discharges to the estuaries and high water conditions in the WCAs, as well as reducing backpumping of agricultural runoff into Lake Okeechobee. Regional above-ground storage within the EAA could capture and store EAA runoff or excess water from Lake Okeechobee during the wet season.

During the dry season, reservoir releases could be made to the primary canals for municipal, Tribal, and agricultural irrigation and for restoration of the downstream Everglades ecosystem. Lake Okeechobee would then no longer be the only supplemental source for meeting EAA irrigation demands. During the periods when supplemental irrigation requirements could not be met by the EAA storage reservoirs, water supply releases from Lake Okeechobee could still be provided.

4.1.4 Fish and Wildlife

4.1.4.1 Everglades and WCAs

Human-induced changes in and around the Study Area have resulted in a substantial reduction in habitat quality for fish and wildlife. In the WCAs, the population of alligators has increased, but nesting success is affected by water levels. Colonial wading birds' feeding and breeding success is also affected by ponded, deep water areas, and altered timing of seasonal drying. During periods of extended high water, accumulation of dead plant material interferes with fish spawning and exerts a large oxygen demand causing fish kills. The fish community structure and abundance is highly dependent on water levels. The fish communities, in turn, provide a major food source for wading birds, alligators, and other carnivores.

4.1.4.2 Lake Okeechobee

In the littoral zone of Lake Okeechobee, the more constant high water levels do not allow for the periodic wetting and drying necessary for the germination of several plant communities, such as willows, which provide nesting substrates for snail kites and wading birds. Fish suffer adverse impacts due to loss of sub-aquatic vegetation and other beneficial plant life that serves as breeding ground and affords protection for juveniles.

4.1.4.3 Northern Estuaries

Releases from Lake Okeechobee to the St. Lucie River and Estuary, southern Indian River Lagoon, and Caloosahatchee River and Estuary have caused declines in submerged aquatic vegetation, benthic invertebrate, and oyster populations. They are important because they provide habitat, food, and oxygen for fish, reptiles, mammals, and invertebrates. Populations of many important recreational and commercial fish have declined due to water pollution and losses of habitat. There are also decreased populations of seabirds, wading birds, and shorebirds due to loss of habitat. In the St. Lucie Estuary, sores on fish have been correlated to large freshwater discharges from Lake Okeechobee.

4.1.4.4 Opportunities

Presently, the design of the major canals within the EAA is constrained in moving water internally within the EAA or from Lake Okeechobee to the south. By incorporating expanded or modified EAA canals with a new water storage area(s), the increased operational flexibility, increased conveyance capacity and converting 32,000 acres of farmland to a storage reservoir could provide additional flood protection to the EAA while protecting the WCAs, Lake

Okeechobee littoral shelves and subaquatic vegetation, and the northern estuaries from damaging high water levels and untimely discharges. When Lake Okeechobee exceeds its regulation schedule, water that currently impacts the lake's littoral zone or disrupts the ecological communities in the northern estuaries, could be moved southward into new storage areas and then, water quality permitting, to the WCAs.

4.1.5 Water Supply to Water Conservation Areas

The C&SF Project compartmentalized natural system areas into Water Conservation Areas (WCAs) to control flooding and to provide a source of water to meet water supply demands. This compartmentalization has altered the hydrologic regime of the natural system communities within the WCAs, including modifying the frequency and duration of hydroperiods and hydropatterns and the magnitude of interannual wet and dry cycles. A portion of the water from the WCAs is allocated to water supply for the heavily populated lower East Coast. Water in the WCAs is needed for industrial, commercial, agricultural, municipal, and residential uses, as well as for protecting the surficial aquifer from salt water intrusion. The WCAs also function as a source of water for Everglades National Park. These competing functions have also lowered the regional ground water in and adjacent to the WCAs.

The EAA Storage Reservoir project represents an opportunity to improve the quantity and timing of delivery of water from the C&SF Project released to natural system communities in the WCAs, particularly WCAs 3A and 3B. Water in Lake Okeechobee that is currently discharged to tide via regulatory releases can be diverted and stored in a reservoir and subsequently delivered to meet environmental targets. Similarly, runoff originating in the EAA can be captured and stored in the reservoir and subsequently released for agricultural water supply purposes.

The EAA Storage Reservoir project will also moderate the flow to STA 3/4. This should enhance the efficiency and longevity of that STA. Reduced nutrient loading coming from the EAA via sequestration in the reservoir should provide long-term water quality benefits to the natural areas in the downstream WCAs.

4.2 PLANNING OBJECTIVES AND CONSTRAINTS

The planning objectives of the project are:

- Improve the timing of environmental deliveries of water to the WCAs,
- Reduce regulatory releases of water from the EAA to the WCAs,

- Reduce regulatory releases of water from Lake Okeechobee to the St. Lucie and Caloosahatchee estuaries,
- Increase flood protection within the EAA.

Flood protection benefits provided by this project will be considered incidental to the additional water management improvements within the EAA.

The constraints are:

- Maintain existing levels of flood protection to agricultural and urban lands (Savings Clause [Section 601 (h)(5) of WRDA 2000]).
- Maintain levels of service for existing (Savings Clause) legal users.
- Minimize impacts to cultural, historical and archaeological resources.
- Minimize adverse socioeconomic impacts on the local and regional economies.
- For the EAA Storage Reservoir Project the key water quality constituents defined by FDEP for discharges to Class III and IV waters are constraints.

4.2.1 Project Evaluation Criteria and Evaluation Methods and Models

The general project evaluation criteria can be summarized into three categories consistent with the CERP:

- Enhance Ecological Values
- Enhance Economic Values and Social Well Being
- Cost, Risk, and Uncertainty

Using these general criteria as guidelines, project-specific performance measures and evaluation methods were established to evaluate alternative plans. Section 5.3 contains additional information on project-specific performance measures utilized to depict ecosystem restoration benefits. Annexes E and G contain additional information on other criteria used to evaluate alternative plans.

4.2.1.1 Evaluation Tools

The following modeling tools were used in the development, optimization, and evaluation of the project:

- Modflow - A three dimensional computer program that is generally used to model the hydrogeology of large areas including their associated hydraulic features. This model has been used to evaluate potential off-site impacts including location and magnitude. This model also is being utilized to evaluate the potential use of cut-off walls to ensure that off-site impacts are within acceptable limits.

- SEEP/W - A two dimensional finite elements computer program. This program is generally used to evaluate relatively smaller areas than the Modflow program. This program has been used to evaluate total seepage from the reservoirs, seepage quantities to the seepage collection canal, exit gradients, and effects of the buffer on the seepage flow.
- SFWMM - Stage-duration curves, hydrographs, water budget analysis, savings clause, and water reservations.
- Natural Systems Model (NSM) - Used to characterize pre-drainage conditions in the EAA Storage Reservoirs Project area.
- HEC-RAS - Alternative canal improvements and hydraulic profiles.
- SEEP/W, Modflow- Seepage collection requirements, effective use interior cells, seepage reduction, seepage buffers and collection operations, flood damage reduction, and savings clause.
- MIKE-SHE (will be used for the Final PIR) – Final hydraulic structure designs.
- IWRPlan - Decision support software.

This page intentionally left blank

SECTION 5
FORMULATION OF ALTERNATIVE PLANS

This page intentionally left blank

5.0 FORMULATION OF ALTERNATIVE PLANS

5.1 PRIOR FORMULATION FROM THE COMPREHENSIVE REVIEW STUDY

In 1999, USACE completed a comprehensive review study of the C&SF project (a.k.a. "Restudy"). The purpose of the Restudy was to reexamine the C&SF Project to "determine the feasibility of structural or operational modifications to the project essential to the restoration of the Everglades and the South Florida ecosystem, while providing for other water-related needs such as urban and agricultural water supply and flood protection in those areas served by the project" (WRDA 1996). The intent of the study was to evaluate conditions within the South Florida ecosystem and make recommendations to modify the C&SF project to restore important functions and values of the Everglades and South Florida ecosystem and plan for the water resources needs of the people of South Florida for the next 50 years. The selected plan (Alternative D13-R) was published as the "Final Integrated Feasibility Report and Programmatic Impact Statement (PEIS) for the C&SF Project" in April 1999.

The plan formulation and evaluation process employed during the Restudy utilized a base set of management measures identified during the reconnaissance phase of the study from which the team formulated comprehensive plan alternatives in a "building block" fashion to achieve desired objectives. In building alternative plans, the Restudy Team considered cost-effective means to achieving the desired output. For example, if a particular least cost component (e.g., increased in-lake storage was the least cost storage option) resulted in an unacceptable adverse impact, then the team selected the next least cost component (e.g., the EAA storage reservoirs) that was effective (greater output) for achieving planning objectives without creating unacceptable adverse impacts elsewhere in the system. The evaluations conducted during the Restudy confirmed that Alternative D13-R resulted in substantial improvements over the other alternative plans in natural system areas in the WCAs and ENP without compromising Lake Okeechobee water levels or water supply to the Lake Okeechobee and Lower East Coast Service Areas in a cost-effective manner.

Since storage of water within the EAA had been established as one of the primary management measures contributing to the goals and purposes of the Restudy, approximately 45,000 acres were acquired in the EAA (the Talisman Lands Exchange Transaction) using federal funds appropriated to the Department of Interior under the authority of the 1996 Farm Bill (Federal Agriculture Improvement and Reform Act of 1996, Public Law 104-127, 110 Stat. 1022). As the Restudy neared completion, there was an effort to identify early opportunities to obtain system-wide benefits by utilizing readily available lands. Therefore, the EAA Storage Reservoirs component of the CERP was separated

into two phases to expedite implementation. The first phase included the construction of two equally sized compartments of 20,000 acre at 6-feet maximum depths. This first phase was conditionally authorized by Congress in Section 601 of the Water Resources Development Act of 2000 (Public Law (PL 106-541). Based on this phased approach, a PMP was prepared to address the EAA Storage Reservoirs Project - Phase 1. However, as the Phase 1 PIR/EIS progressed, it became apparent that formulating and evaluating the two phases separately would result in an incomplete solution to the problems the EAA Storage Reservoirs project was intended to address. Not constraining the plan formulation and evaluation and design to phases or the three cell configurations as initially authorized allowed the design optimization to develop a more cost-effective plan than would have resulted from a phased approach. Therefore, it was subsequently determined that the entire EAA project should be formulated and evaluated as one project. This will require modification to the existing authorized project.

Plan formulation for this project implementation report focused on affirming that an above-ground storage reservoir in the EAA continues to meet the goals, objectives, and purposes for the project. The problems, opportunities, goals and objectives and constraints described in the existing and future without-project steps in this report are generally unchanged from those identified in the Restudy. Modifications to the without project condition, notably the acquisition of the Talisman lands, is addressed and does not impact plan selection.

In general, the plan formulation was conducted by affirming that above –ground storage in the EAA is a cost-effective solution to achieving the benefits identified in the Restudy by screening different storage locations within the system. This screening analysis concluded that storage within the EAA is the most cost-effective method to begin achieving the goals and regional storage objectives of CERP. To complete the plan formulation, alternative plans with different configurations and sizes were compared to determine the cost-effectiveness of various storage depths, including a range of footprints and different construction techniques. Additionally, on-site management measures were developed and evaluated.

5.2 PLAN FORMULATION RATIONALE

5.2.1 Preliminary Screening

Lake Okeechobee is considered the "liquid heart" of South Florida's interconnected Kissimmee River/Lake Okeechobee/Everglades systems. It is the critical source of water for other wetland components of the South Florida ecosystem, the Lake Okeechobee service area, the remaining portions of the historic Everglades, the urbanized areas of the Lower East Coast of Florida, and Florida Bay.

Prior planning efforts have concluded that additional water storage areas must be located near Lake Okeechobee as this will ensure a robust hydraulic connection to the lake and the flexibility needed to better manage high water levels in the lake. Proposed locations and management measures for achieving additional water storage in the vicinity of Lake Okeechobee include:

1. Additional Storage in Lake Okeechobee,
2. Storage North of Lake Okeechobee,
3. Storage East and West of Lake Okeechobee,
4. Aquifer Storage and Recovery Systems (ASR)
5. Flow-way from Lake Okeechobee to WCAs, and,
6. Storage South of Lake Okeechobee in the EAA (recommendation of Restudy).

In this section, the efficacy and environmental implications of each of these locations and management measures are assessed, in addition to a consideration of cost-effectiveness.

5.2.1.1 Additional Storage in Lake Okeechobee

Additional water storage could be accommodated in Lake Okeechobee. Storage could be provided by adjusting the lake regulation schedule (known as WSE 25 and set to allow lake levels to fluctuate between 15.5 and 17.5 NGVD) to allow higher lake levels to provide the needed dry season environmental and agricultural deliveries, while restricting the wet season discharge to the estuaries and WCAs. In order to maintain protection of surrounding land uses, the Herbert Hoover Dike (HHD) around the lake would also need to be modified to accommodate the higher water levels.

Additional water stored in the lake could meet the following project planning objectives:

1. Improve the timing of environmental deliveries of water to the WCAs. More water would be available to meet the needs of the natural system when the natural system needs it.
2. Reduce Lake Okeechobee regulatory releases of water to the WCAs. The lake could hold back water and not send it to the WCAs when the WCAs already have too much water.
3. Reduce regulatory releases of water from Lake Okeechobee to the St. Lucie and Caloosahatchee Estuaries. The lake could hold back water and not send it to the estuaries in such large volumes that their natural salinity regimes are harmed.

4. Meet agricultural demands within the EAA. This is the current condition. Water is provided to meet the needs of agriculture.
5. Increase flood protection within the EAA. Water could be backpumped (this is allowed under current law without having to treat the water) from the EAA to storage within the lake to reduce flood damage.

This management measure and location was rejected because the harmful impacts to the Lake Okeechobee littoral zone would outweigh the benefits and this is consistent with the "Options for Consideration" by the Governor's Commission for a Sustainable South Florida, 1995. The lake's natural resources are dependent on the littoral zone since it provides nursery areas, spawning areas, foraging areas, and roosting areas required for the completion of life cycles. The frequency and duration of inundation of the lake littoral zone would increase with higher lake levels under a revised regulation schedule, which would have severe impacts on the littoral zone. High lake stages result in loss of beneficial littoral zone plant communities in favor of introduced exotics (e.g., torpedo grass) as well as impacts to wading birds and other water-dependent wildlife. Higher lake stages are also associated with increased in-lake nutrient loading, turbidity, and increased frequency of blue-green algal blooms (SFWMD, 2000).

During development of the CERP, it was important to make progress toward all ecological and hydrological targets; achieving a target in one area or toward some planning objective should not cause damage to another area or be at the expense of other objectives. While it was not possible to achieve every performance measure target, resulting in the need to make trade-offs among competing objectives (e.g., between providing additional storage in the Lake Okeechobee region and minimizing impacts to the lake's littoral zone), guidelines were established to set priorities among performance measure targets. One of the guidelines was that Everglades restoration should not cause additional, long-term ecological damage. Since there are other means of providing storage adjacent to Lake Okeechobee without causing ecological damage to the lake's littoral zone, this option (increased in-lake storage) is determined to be less effective and less acceptable than other regional storage options included in the CERP recommended plan (D-13-R) (USACE & SFWMD, Final Feasibility Report, 1999). It is anticipated that an additional 0.8 feet of storage in the lake would result in significant habitat loss. Evaluations performed during the Restudy indicated that this would result in a reduction in 140,000 habitat units.

It was also noted that increasing the capacity of Lake Okeechobee would result in an increased risk of regulatory releases to the Atlantic and Gulf estuaries and the Everglades. Such regulatory releases would occasionally be necessary to keep the lake level from exceeding maximum levels and would be expected to

adversely affect natural system areas receiving such discharges. Increasing lake levels would also create additional operation, maintenance, and rehabilitation and repair requirements to ensure that the Herbert Hoover Dike surrounding Lake Okeechobee could safely contain the volume of additional water.

5.2.1.2 Storage North of Lake Okeechobee

The Comprehensive Plan (Restudy) includes water storage and water quality treatment north of Lake Okeechobee with the objectives of improving water quality entering the lake and reducing the duration and frequency of both high and low water levels in Lake Okeechobee. The Lake Okeechobee Watershed Study is currently underway that includes formulation and evaluation of the Restudy Compartment A (North of Lake Okeechobee Storage Reservoirs), Compartment W (Taylor Creek/ Nubbin Slough Storage and Treatment Area), and Lake Okeechobee Watershed Water Quality Treatment Facilities. These features total approximately 250,000 acre-feet of storage and 11,875 acres of STAs.

These reservoirs could be expanded to include a portion of the storage that the EAA Storage Reservoirs project is designed to hold. Additional water stored in above ground reservoirs north of the lake could meet the following planning objectives:

1. Improve the timing of environmental deliveries of water to the WCAs. More water could be stored north of the lake and moved to the lake and then southward through the EAA to the WCAs to meet the needs of the natural system.
2. Reduce Lake Okeechobee regulatory releases of water to the WCAs. The north of lake storage could withdraw water from or capture water before it enters the lake. This would reduce the need to release lake water southward to the WCAs to meet regulation schedules when the WCAs already have too much water.
3. Reduce regulatory releases of water from Lake Okeechobee to the St. Lucie and Caloosahatchee Estuaries. The north of lake storage could withdraw water from or capture water before it enters the lake. This would reduce the need to release lake water to meet regulation schedules to the east and west estuaries in such large volumes that their natural salinity regimes are harmed.
4. Meet agricultural demands within the EAA. More water could be moved from north of the lake to the lake and thence southward to the EAA to meet the needs of agriculture.
5. Increase flood protection within the EAA (flood runoff could be backpumped from the EAA through the lake to storage north of the lake to reduce flood damages).

This location would require that the runoff from the EAA be pumped north through Lake Okeechobee and again pumped into storage reservoirs. This would require extensive pumping facilities to physically transfer the water, as well as treatment of the water before allowing it to enter the lake and again prior to discharging back to the lake to meet current state water quality standards. It should also be noted that expanding the size of the reservoirs will take additional property off the tax roles in largely rural counties. This would be expected to have negative impacts on the socioeconomic components of the environment in these counties.

5.2.1.3 Storage East and West of Lake Okeechobee

The Comprehensive Plan includes water storage in the basins to the east and west of the lake. For the C-43 basin west of the lake, the objectives are capturing basin runoff and releases from the lake to provide water supply, attenuation of regulatory releases, water supply deliveries to the Caloosahatchee Estuary, and water quality benefits to reduce salinity and nutrient impacts of runoff to the estuary. For the C-44 basin east of the lake, which is incorporated into the Indian River Lagoon PIR, the objectives of the storage reservoirs are capturing basin runoff to provide flood flow attenuation to the estuary, water supply deliveries to the estuary, and water quality benefits to the St. Lucie Estuary by reducing salinity and nutrient impacts of runoff to the estuary. The C-43 Basin Storage Reservoirs project implementation report is currently underway and includes formulation and evaluation of Restudy Compartment D (C-43 Basin Storage Reservoir) estimated in the Comprehensive Plan to total approximately 160,000 acre-feet of storage. The Indian River Lagoon PIR has been completed and approved by the Chief of Engineers, and includes the C-44 reservoir, totaling approximately 33,150 acre-feet of storage and 6,000 acres of STAs. (The Indian River Lagoon [IRL] project includes other project features outside of the C-44 basin.)

These reservoirs could conceivably be expanded to include the additional storage that the EAA Storage Reservoirs project is intended to hold. Additional water stored in above-ground reservoirs to the west and east of the lake could meet the following planning objectives:

1. Improve the timing of environmental deliveries of water to the WCAs. More water could be moved from east or west of the lake to the lake and then southward through the EAA to the WCAs to meet the needs of the natural system.
2. Reduce Lake Okeechobee regulatory releases of water to the WCAs. The storage east or west of the lake could receive water from or hold water back from entering the lake. This would reduce the need to release lake

water southward to the WCAs to meet regulation schedules when the WCAs already have too much water.

3. Reduce regulatory releases of water from Lake Okeechobee to the St. Lucie and Caloosahatchee Estuaries. Storage in both the C-44 and C-43 basins to the east and west of the lake can hold water back and not send it to the lake or the estuaries. This would reduce the need to release lake water to meet regulation schedules to the east and west estuaries in such large volumes that their natural salinity regimes are harmed.
4. Meet agricultural demands within the EAA. More water could be moved from east and west of the lake to the lake and then southward to the EAA to meet the needs of agriculture.
5. Increase flood protection within the EAA. Flood runoff could be backpumped from the EAA through the lake to storage east and west of the lake to reduce flood damages.

To capture excess agricultural runoff from the EAA, like the north of Lake Okeechobee location, the water would be pumped north through Lake Okeechobee and again pumped east or west into storage reservoirs. This would require new, massive pumping systems and treatment systems for the water. Treatment is required before water is allowed to enter Lake Okeechobee and again prior to discharging back to the lake to meet current state water quality standards.

Water stored in expanded reservoirs east and west of Lake Okeechobee must ultimately be released either back to the lake to increase the quantity of water delivered to the Everglades or to one or both estuaries. While peak regulatory releases to the estuaries may be further moderated with additional storage east and west of Lake Okeechobee, it seems likely that this concept could result in more freshwater sent to the estuaries than is being planned for in the C-43 Basin Storage Reservoir and IRL-South projects and less efficient delivery of additional water to the WCAs. Thus, this location most likely would not achieve the entire ecosystem benefits in the Caloosahatchee and Indian River Estuaries that would be achieved by locating the EAA Storage Reservoirs project elsewhere.

Expanding the size of the reservoirs for this option will also take additional property off the tax roles in largely rural counties. This would be expected to have negative impacts on the socioeconomic components of the environment in these counties.

5.2.1.4 Aquifer Storage and Recovery Systems (ASR)

The Comprehensive Plan already includes the Lake Okeechobee ASR Compartment (Compartment GG) as well as the C-43 Basin ASR Compartment

(Compartment D). The former includes a series of 200 aquifer storage and recovery wells adjacent to Lake Okeechobee with a capacity of 5 million gallons per day each (1 billion gallons per day in total) and associated pre and post water quality treatment facilities to treat the water to drinking water standards prior to injection into the Upper Floridan Aquifer and after recovery from the aquifer. The latter includes a series of 44 ASR wells in the C-43 basin with a capacity of 5 million gallons each per day (220 million gallons per day in total) and associated pre and post water quality treatment facilities.

In terms of acre-feet of storage, each well in the ASR system would have the capacity to inject 5,601 acre-feet of water into the Upper Floridan Aquifer (for later retrieval) on an annual basis, provided enough water was available within the natural system (from rainfall, runoff, etc.) to do so. (To actually calculate expected storage within the ASR system would require running simulations using the 31-year period of record to determine when, historically, there was sufficient or excess water available to be injected into the Aquifer.) The combined capacities of the Lake Okeechobee and the C-43 basin ASR projects would thus be 1,366,625 acre-feet per year. The ASR pilot project and regional study are currently underway to address some of the technical and regulatory uncertainties associated with implementing ASR systems on a large scale, such as options for surface water withdrawal, injection and pumping cycles, water quality, the effects of pumping cycles on groundwater and ecosystems, and appropriate siting of ASR wells. While test results will not be available until 2010, presumably the ASR systems could be expanded in terms of number of wells or well pumping capacity for injection and retrieval of water to include the additional storage that the EAA Storage Reservoirs project requires.

Additional water stored in underground ASR systems, either surrounding Lake Okeechobee or within the EAA region, could meet the following EAA planning objectives:

1. Improve the timing of environmental deliveries of water to the WCAs. More water could be stored in ASRs surrounding the lake and moved to the lake and then southward through the EAA to the WCAs to meet the needs of the natural system.
2. Reduce Lake Okeechobee regulatory releases of water to the WCAs. The ASRs surrounding the lake and those in the Caloosahatchee basin could withdraw water from the lake. This could reduce the need to make lake regulatory releases southward to the WCAs when the WCAs already have too much water.
3. Reduce regulatory releases of water from Lake Okeechobee to the St. Lucie and Caloosahatchee Estuaries. The ASRs surrounding the lake and those in the Caloosahatchee Basin could withdraw water from the lake. This could reduce the need to make lake regulatory releases to the east

and west estuaries in such large volumes that their natural salinity regimes are harmed.

4. Meet agricultural demands within the EAA. More water could be moved from north of the lake to the lake and then southward to the EAA to meet the needs of agriculture.

Storing additional water in ASR systems rather than in reservoirs raises a high level of technological and regulatory uncertainty. There are ongoing ASR pilot projects and regional studies to address these uncertainties. While the technological and regulatory uncertainties will likely be reduced as a result of the pilot project results, it is still not likely that large-scale ASR systems capable of storing the volumes of water associated with regulatory releases will be implemented in an expedited manner. Uncertainties related to required water quality treatment technologies and recovery efficiencies (currently, only 70% of the water injected into ASRs is assumed to be recoverable) also greatly affect ASR project cost estimates. Further, ASR has a slower rate of water capture and discharges compared to above-ground reservoirs. The rate of capture (from Lake Okeechobee or a canal) is limited at each well site (to a maximum of 15 acre-feet per day, as compared to 6,942 acre-feet per day on average for each pump at above ground storage reservoirs to capture from the lake or a canal). This would significantly limit the system's ability to store regulatory releases from the lake needed to keep the lake below its maximum allowable level.

5.2.1.5 Flow-way (broad, shallow marsh areas for free flow of water from Lake Okeechobee to WCAs)

A flow-way is a passive measure generally described as a broad, shallow marsh area that is used to freely-flow water from Lake Okeechobee to one or more of the WCAs. This management measure was developed during the Restudy to restore sheet flow between the EAA and the WCAs. The flow-way would provide for sheet flow and dynamic water storage. Various flow-way designs were considered ranging from 1 to 3 miles wide and varying lengths to identify relative differences in the hydrological and environmental response.

The evaluation of this concept showed a number of problems concerning feasibility, such as soil subsidence in the EAA, evapotranspiration losses, seepage management, vegetation management, timing of flows and frequency of flow events and the feasibility of acquiring necessary real estate interests. Additional EAA issues included numerous roads, bridges, and railroad relocations that would be required if a flow-way divides the entire EAA.

Soil subsidence in the EAA has substantially reduced ground levels in the southern portions of the EAA and would reduce the hydraulic head that would drive the southward flow of water; hence, velocities and flow rates would be greatly reduced. By spreading the water over shallower areas (as opposed to

reservoirs) and because a marsh habitat would have to be kept hydrated, the evapotranspiration loss would be much higher than for reservoirs, thereby significantly reducing the storage value of these areas. A long, rectangular configuration would have a 75% longer levee than a traditional storage reservoir, thus increasing environmental impacts, project cost, and the area devoted to seepage management features. Because nutrient-laden soil would be flooded for the flow-way, the vegetation most likely to dominate would be cattails and other invasive exotics that would degrade the Everglades habitat.

Flow-ways would not "hold back" water going to the WCAs and the delivery of that water would exacerbate the already high stages in the northern parts of the WCAs. Thus, the timing of flows from flow-ways would not be manageable or beneficial for the remaining Everglades. Perhaps the most crucial element, water flowing from the lake to the WCAs is not present in dry or even normal years. For example, during long periods (e.g., from 1970-1982 and 1985-1994 in the hydrologic modeling period of record), no significant excess lake water would be available for delivery to the flow-way. Only demand releases to the Everglades were made from the lake during those periods. Water delivered to the Everglades on a demand basis, through a flow-way, would not be efficient due to increased travel times and increased evapotranspiration losses. The only years in the period of record where water could flow through the flow-way for long durations were wet periods like 1969-1970, 1982-1983, and 1994-1995. In those years, the stages in the WCAs were already too high and additional flow from flow-ways would have been damaging, not beneficial. Perhaps the most important reason why flow-ways were not included in the Comprehensive Plan was because of the significant water losses that would be unacceptable in an ecosystem in which dry season performance was already impacted. Flow-ways would place an additional hydrological demand on the system.

5.2.1.6 Storage South of Lake Okeechobee in the EAA

Creating above-ground reservoirs south of Lake Okeechobee in the EAA could meet all the planning objectives:

1. Improve the timing of environmental deliveries of water to the WCAs,
2. Reduce regulatory releases of water from the EAA to the WCAs,
3. Reduce regulatory releases of water from Lake Okeechobee to the St. Lucie and Caloosahatchee estuaries,
4. Meet agricultural demands within the EAA, and,
5. Increase flood protection within the EAA.

This option would avoid pumping water through Lake Okeechobee with its attendant treatment requirements. It has the advantage of robust hydraulic connections with both the lake and the EAA through the existing canals. It also

has the advantage of potential enhancement of STA operation by intercepting peak flows during wet periods and retaining water during dry periods while metering water output to the STAs.

Depending upon placement and the size of the reservoirs, this option may remove property from the tax roles in Palm Beach County, with its associated negative impacts on the socioeconomic components of the environment in this county. However, it should be noted that the Talisman lands within the EAA have already been acquired via an appropriation of Federal funds and SFWMD funds in anticipation of implementation of a project contributing to the overall restoration of the South Florida ecosystem. According to the Palm Beach County Property Appraiser, the value of land in the EAA decreases with distance from Lake Okeechobee. Land near the Everglades Construction Project STAs and WMAs at the south end of the EAA was valued at a little more than 40% of the value per acre of the land next to the lake. Apparently, this is related to the relatively poor agricultural productivity of this land when compared to the land adjacent to the lake. For the same reason, large acreages of land are available in the southern end of the EAA. Some of the parcels in this area are also adjacent to STAs to receive reservoir water and the canals to connect the reservoirs with Lake Okeechobee.

5.2.2 Conclusions

Based on the above-described screening analysis, there is no compelling reason to pursue meeting the planning objectives elsewhere within the study area. Also, cost-effectiveness analyses performed during the Restudy demonstrated that the EAA storage reservoirs were more cost-effective on a cost per acre-foot of storage than most of the options described above. Table 5-1 displays the average annual cost per acre-foot storage. Although the C-43 basin was also demonstrated to be more cost-effective, the cost of back-pumping the stored water "through the lake" to meet the EAA planning objectives is not captured in this cost and would greatly increase the cost of storing water in this location.

TABLE 5-1: COST PER SQUARE-FOOT OF WATER STORED.

Option	Cost* per Acre-Foot
Storage North of Lake Okeechobee	$374
Storage West of Lake Okeechobee (C-43)	$134
Storage East of Lake Okeechobee (C-44)	$328
Aquifer Storage and Recovery (ASR)	$822
Storage South of Lake Okeechobee in the EAA	$181
* In 1999 dollars	

In summary, initial screening determined the project as described in the Restudy achieves the desired benefits in a cost-effective manner. Based upon the information, it is apparent the best location for the proposed reservoirs is

within the EAA, south of Lake Okeechobee. Five parcels were identified as possible locations shown in Figure 1-3. Two adjacent parcels totaling 31,494 acres were identified as Compartment A. Two other adjacent parcels totaling 9,302 acres became Compartment B. The last parcel of 8,884 acres was identified as Compartment C.

5.3 ALTERNATIVE PLANS

The formulation and evaluation of alternative plans were consistent with the Draft Program-Wide Guidance Memorandums #1 and #2 regarding the development of design alternatives to optimize project features, cost-effectiveness, and satisfaction of the requirements of the CERP Programmatic Regulations. Different storage configurations, various storage depths, a range of footprints, and several construction techniques were developed and evaluated. Additionally, on-site management measures were developed and evaluated to provide additional ecological benefits.

5.3.1 Evaluation Tools

The modeling tools used in the development, optimization, and evaluation of the alternatives consisted principally of a regional-scale hydrologic simulation model (the South Florida Water Management Model) and other modeling tools. These are described in an earlier section (4.2.1).

5.3.2 Alternative Plans Descriptions

A total number of six alternative plans were considered as part of the plan optimization process. Alternative 1 is the "No Action" plan, and the remaining 5 plans all have a storage capacity of 360,000 acre-feet. The maximum normal pool depths for the alternatives are 6 feet, 10 feet, 12 feet, and 14 feet. The alternatives are similar with the exception of reservoir footprint, embankment height, and embankment construction method. Four alternatives are designed with earthen fill embankments and 1 alternative was designed using roller compacted concrete (RCC) embankment construction. RCC construction was evaluated as a possible cost-saving construction method during a value engineering exercise after the initial construction and cost estimates of the earthen embankment plans. The RCC design and planning cost estimate was developed for the 12-foot storage depth alternative, as this depth and configuration was indicated as the most cost-effective plan.

All of the “action” alternatives include inflow pump stations (using existing and new pump stations), gated discharge spillways to North New River and Miami Canals and STA-3/4, an internal embankment and internal gated spillway(s) for cell stage equalization, and seepage control canals with associated structures. Table 5-2 provides a summary of reservoir alternatives.

TABLE 5-2: SUMMARY OF RESERVOIR ALTERNATIVES.

Alternative Designation	Depth (ft)	Area (Ac)	Storage (acre-feet)	Embankment Type
Alt 2	6	62,000	360,000	Earthen
Alt 3	10	38,000	360,000	Earthen
Alt 4	12	32,000	360,000	Earthen
Alt 5	12	32,000	360,000	RCC
Alt 6	14	26,500	360,000	Earthen

Embankment heights were set approximately 6.7 feet and 7.7 feet (11 feet and 12 feet above normal pool) above maximum surcharge pool elevations for earthen and RCC levee designs, respectively. An internal embankment that runs north to south was included to compartmentalize the reservoirs, thus creating 2 cells, which adds operational flexibility, and reduces perimeter embankment height by reducing the wind setup/wave run up fetch length. Seepage would be intercepted and collected in a canal that runs along the reservoir's western, northern, and eastern boundaries. The existing STA-3/4 supply canal would be utilized to intercept seepage to the south. A 35-foot wide littoral shelf was included along the entire length of the seepage canal. A 200-foot wide seepage management buffer was included along the entire length of the seepage canal. In addition to serving as a seepage management measure, this feature could also could provide environmental benefits (habitat for fish and wildlife). It is expected that the proposed reservoirs will improve the performance of STA-3/4 by acting as a surge tank to equalize flows. The EAA reservoirs will also improve water quality by providing residence time for settling of contaminants prior to input into STA-3/4.

Alternative plans are shown in Figures 5-1 through 5-4. Reservoir design parameters for each of the alternatives are summarized in Tables 5-3 through 5-6. The footprint, pumps, and structures are identical for the earthen and RCC embankment alternatives.

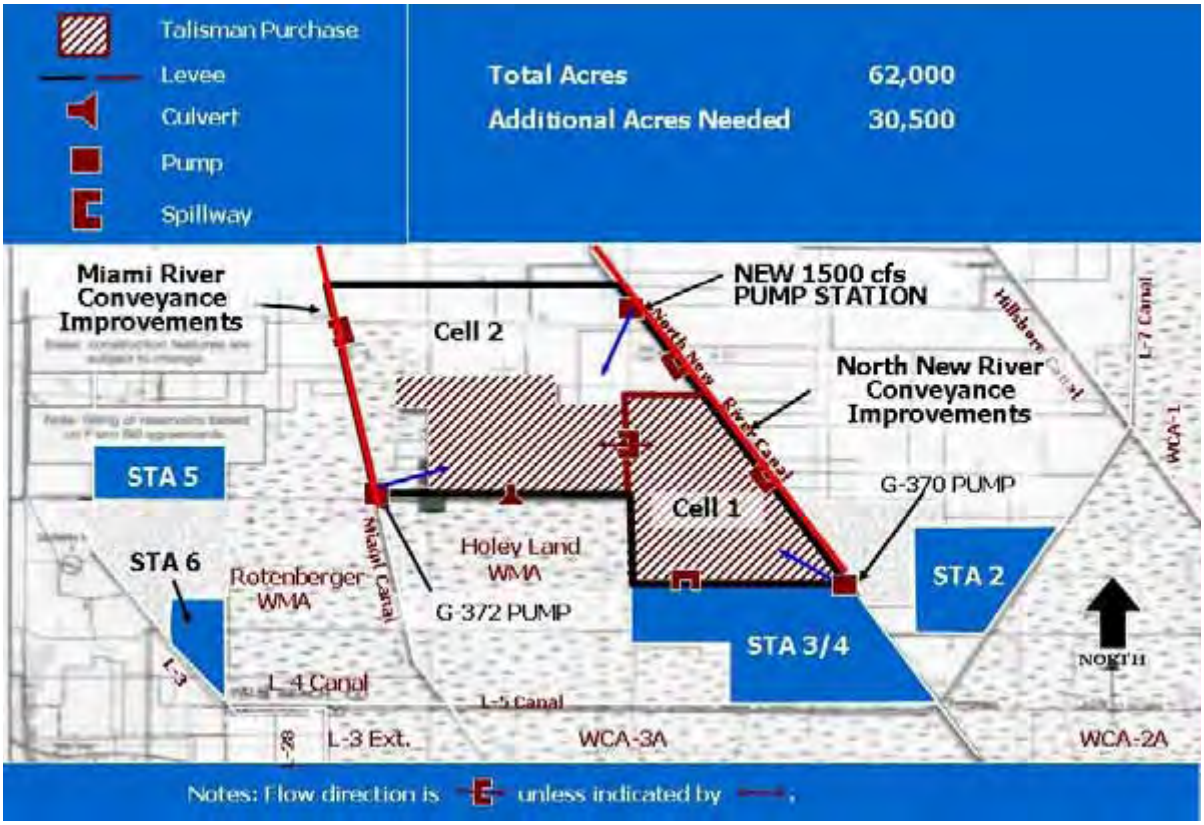

FIGURE 5-1: ALTERNATIVE 2 DESIGN LAYOUT.

TABLE 5-3: ALTERNATIVE 2 DESIGN SUMMARY.

Design Parameter	Parameter Values	
	Cell 1	Cell 2
Storage Area (acres)	17,000	45,000
Normal Pool Depth (feet)	6	6
Total Fill Rate (cfs)	2,775	5,200
Time to Fill (days)	19	26
Drawdown Rate (cfs)	4,000	6,000
Time to Drawdown (days)	13	23

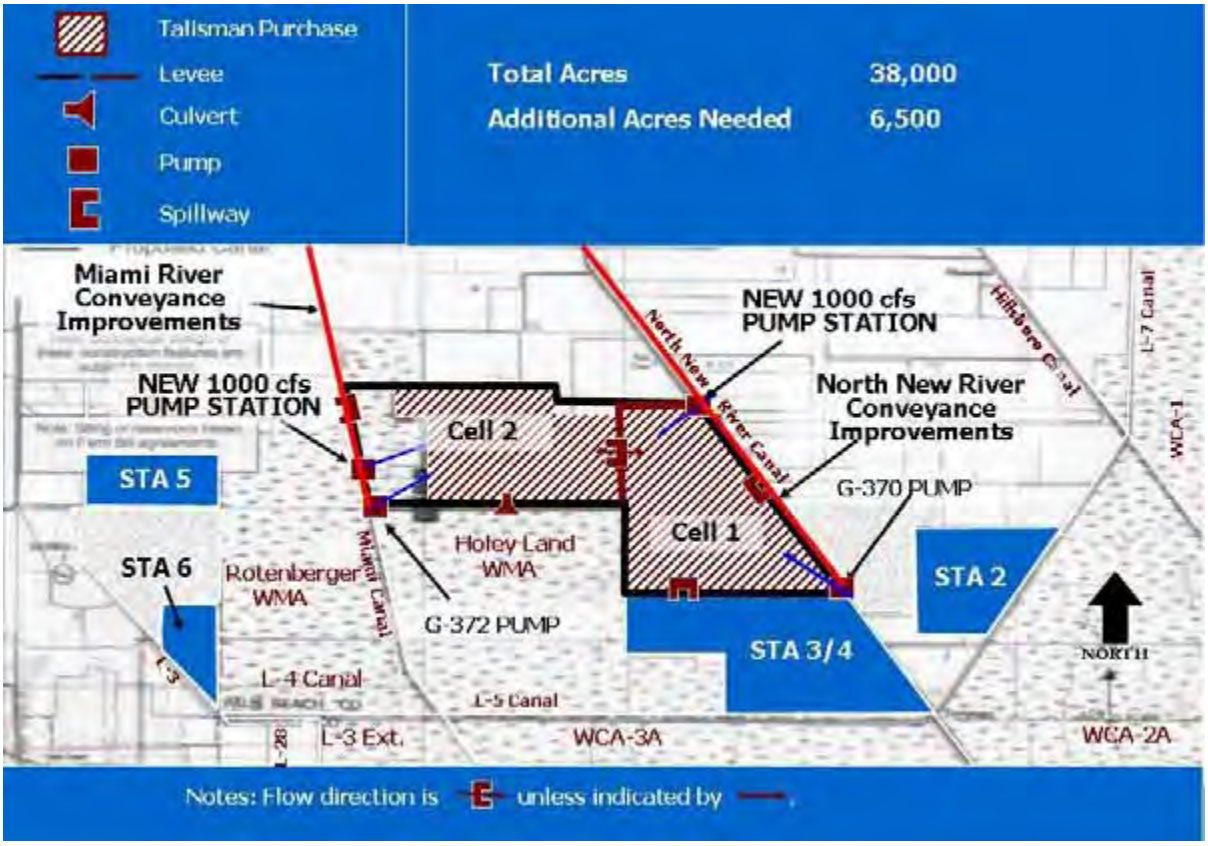

FIGURE 5-2: ALTERNATIVE 3 DESIGN LAYOUT

TABLE 5-4: ALTERNATIVE 3 DESIGN SUMMARY.

Design Parameter	Parameter Values	
	Cell 1	Cell 2
Storage Area (acres)	17,000	21,000
Normal Pool Depth (feet)	10	10
Total Fill Rate (cfs)	3,300	4,200
Time to Fill (days)	26	24
Drawdown Rate (cfs)	4,000	4,000
Time to Drawdown (days)	21	25

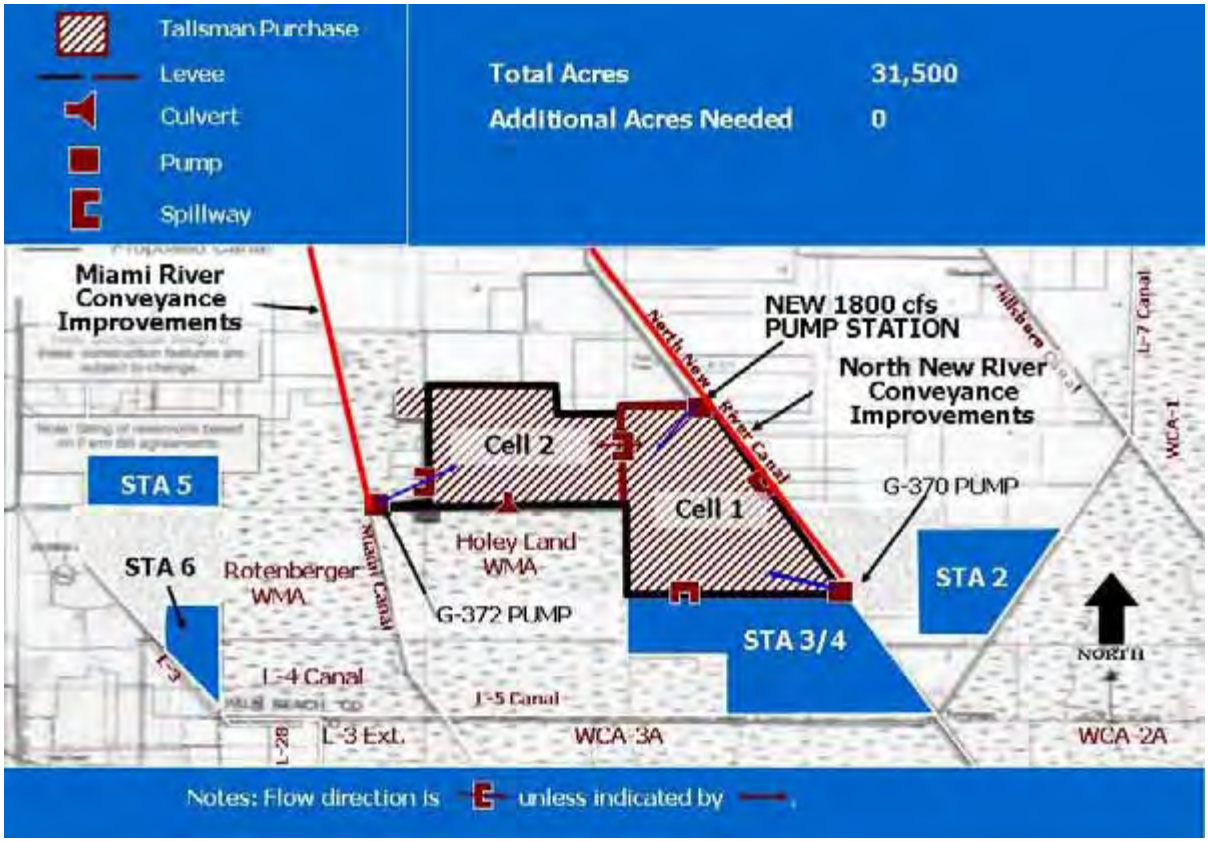

FIGURE 5-3: ALTERNATIVES 4 AND 5 DESIGN LAYOUT

TABLE 5-5: ALTERNATIVES 4 AND 5 DESIGN SUMMARY.

Design Parameter	Parameter Values	
	Cell 1	Cell 2
Storage Area (acres)	17,000	14,500
Normal Pool Depth (feet)	12	12
Total Fill Rate (cfs)	3,900	3,000
Time to Fill (days)	26	24
Drawdown Rate (cfs)	4,000	4,000
Time to Drawdown (days)	26	21

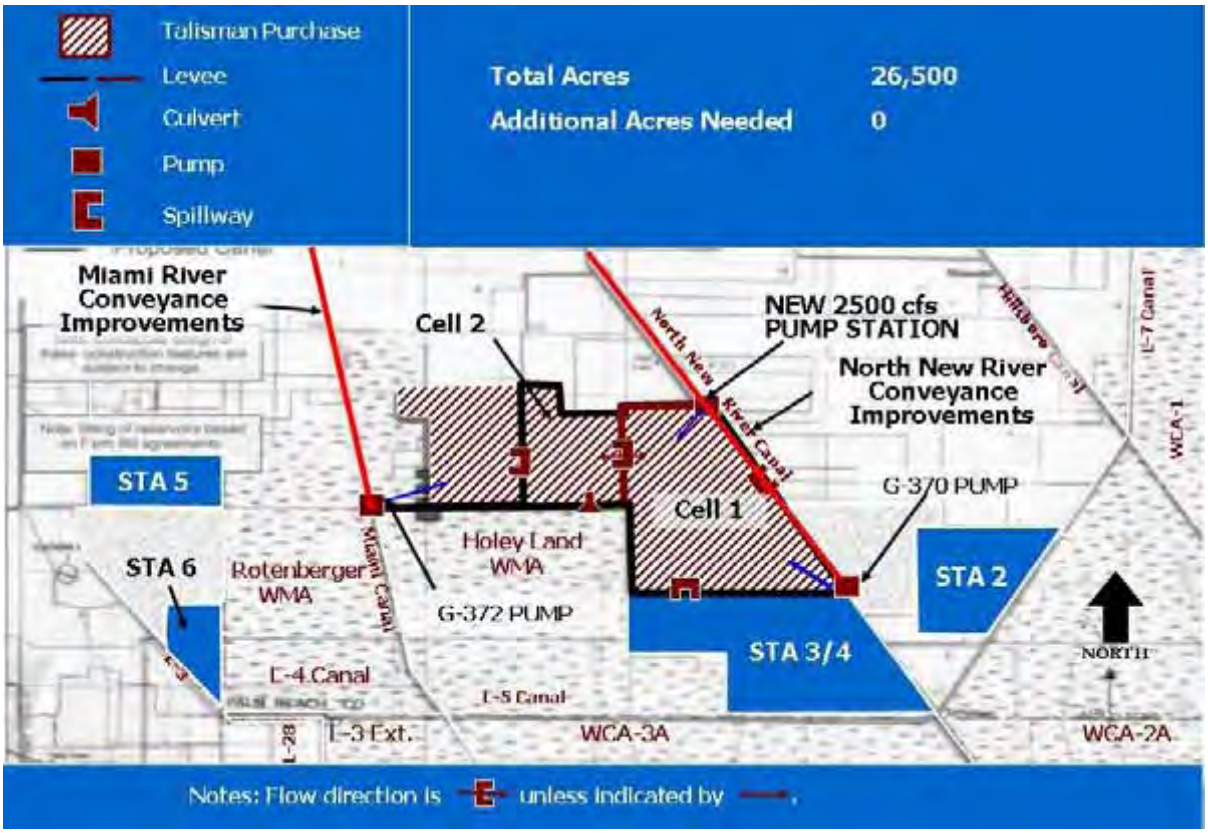

FIGURE 5-4: ALTERNATIVE 6 DESIGN LAYOUT

TABLE 5-6: ALTERNATIVE 6 DESIGN SUMMARY.

Design Parameter	Parameter Values	
	Cell 1	Cell 2
Storage Area (acres)	17,000	9,500
Normal Pool Depth (feet)	14	14
Total Fill Rate (cfs)	3,900	3,000
Time to Fill (days)	26	24
Drawdown Rate (cfs)	4,000	4,000
Time to Drawdown (days)	26	21

5.3.2.1 Reservoir Embankment Construction

As indicated above, two types of embankment construction were considered for the EAA reservoirs. These include an earthen design for all alternatives evaluated including the selected plan (Alternative 4), and an RCC design (Alternative 5). Earthen embankments would be constructed in their entirety from the materials found on the Project site (limestone layer found under the cap-rock layer). RCC embankments would be built solely of the processed cap-rock layer, with the addition of Portland cement and fly ash shipped in from external sources. The majority of the materials would come from borrow areas within the reservoir footprint while a small portion would be provided from the

excavation of the seepage collection canal. The seepage canal construction would produce between 5% and 10% of the embankment material. The borrow pits would produce the required balance of embankment material. Embankments will be constructed with a crest width of 12 feet. Earthen embankments would have 1 (vertical) on 3 (horizontal) slopes on both sides. The exterior RCC embankments would be built with a vertical face on the flood, or interior, side and a stepped face on the exterior or dry side of the reservoirs. The stepped face would consist of three equally spaced steps. A 20-foot wide maintenance/service road would be placed on the toe of the exterior side of either type of embankment. The road would be unpaved and constructed with the same limestone material used for the embankment. The interior slopes of the earthen embankments would be protected with riprap, while the outside slopes would be grassed. Neither face of the RCC embankment requires any protection or cover. The embankment located between cells 1 and 2 would not have a service road at the toe. However, both sides of this "internal" embankment would be protected by riprap. See Figure 5-5 for a typical earthen levee section and Figure 5-6 for a typical RCC levee section.

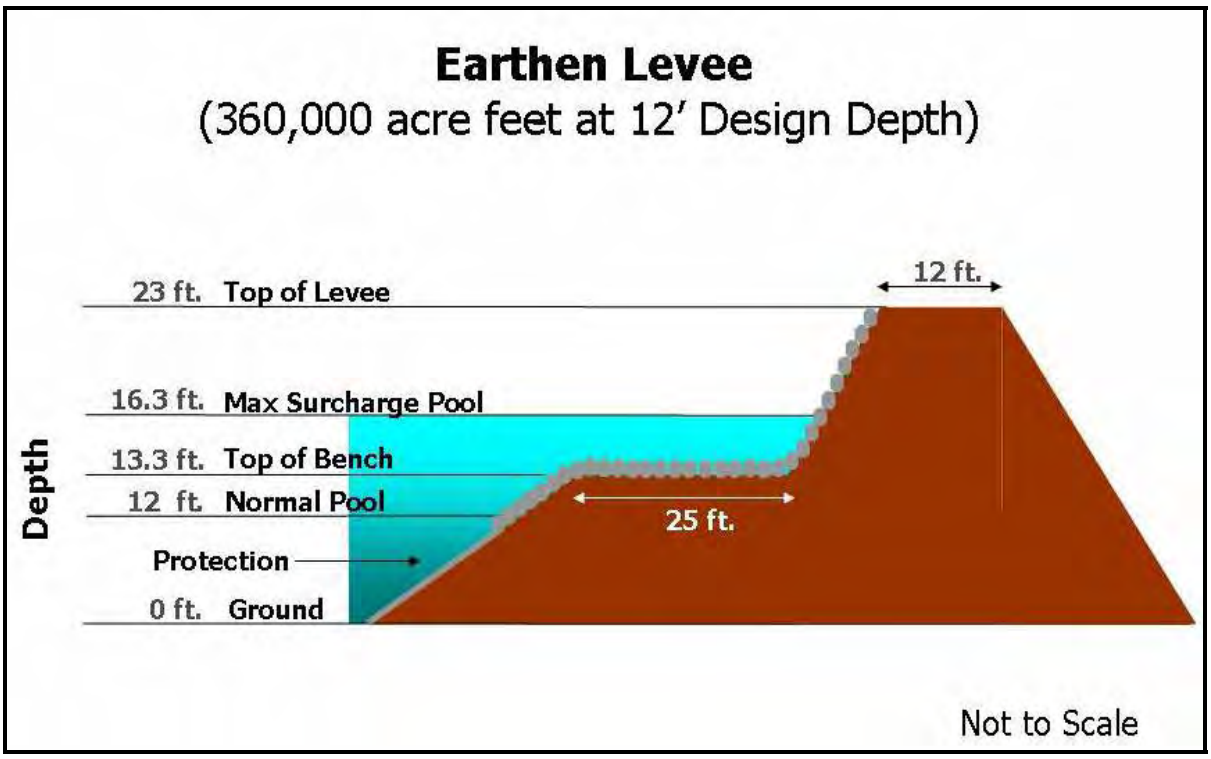

FIGURE 5-5: TYPICAL EARTHEN LEVEE SECTION

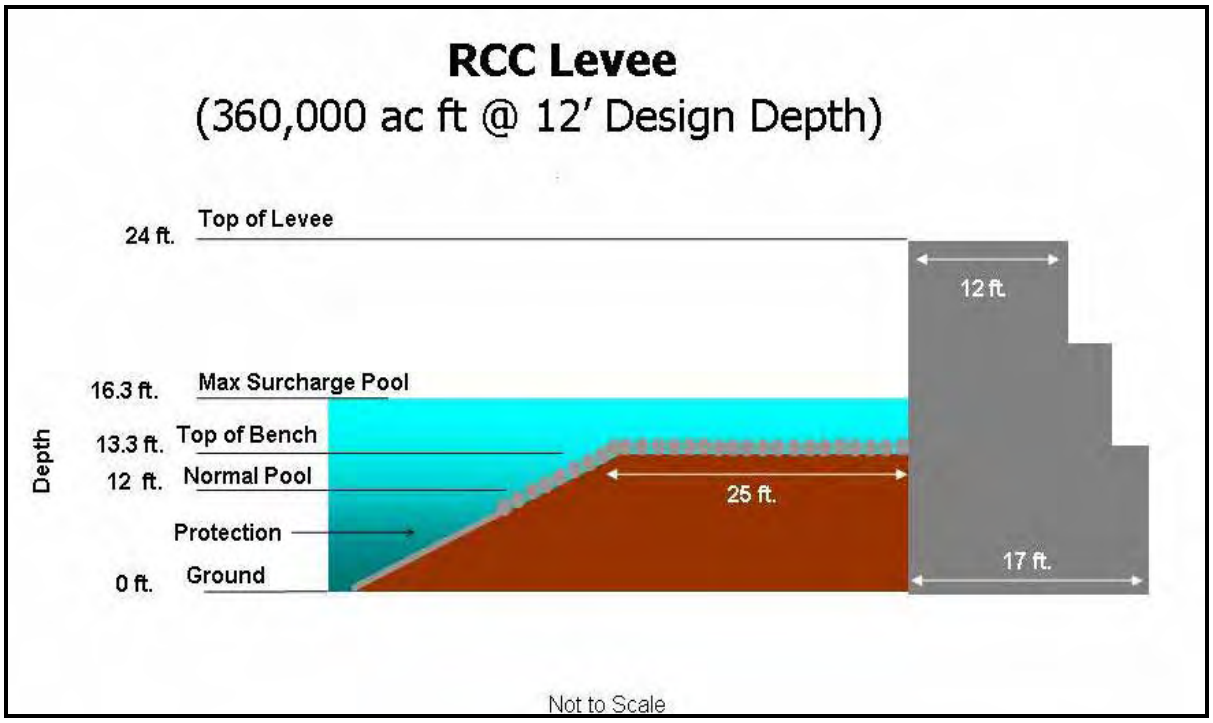

FIGURE 5-6: TYPICAL RCC LEVEE SECTION

Currently, the total construction cost estimates are within approximately 7% for both the earthen and RCC embankments. Design assumptions and requirements have been refined based upon the results of a project recently constructed and operated by the SFWMD. The objectives of this project, called "Temporary Test Embankment Cell Construction," were to: 1) obtain performance data on the seepage potential at the reservoir site, 2) evaluate the suitability of on-site materials for embankment construction and slope protection, and, 3) determine the suitability of cap rock for chimney and drain materials.

5.3.2.2 Cut-off Wall

Based on the preliminary evaluation of embankment stability and potential off-site impacts, cut-off walls will be needed for the EAA reservoirs. The cut-off wall would ensure that off-site impacts are within acceptable limits and that exit gradients have adequate safety factors against potential piping failure. For earthen embankments, it is estimated that a 35 feet cut off wall will be needed along the east side (US-27), north and west sides (agricultural areas), and along STA 3/4 side in the south. Along the Holey land area to the southwest, a 50-foot deep cut-off wall is recommended. For the roller compacted concrete embankment, a 50-foot deep cut-off wall is recommended along the entire reservoir perimeter. The cut-off wall will be composed of soil-bentonite mix with a minimum width of 3 feet. The cut-off wall evaluation is presented in details in the Engineering Appendix.

5.3.2.3 Wave Breaking Bench

A wave breaking bench is planned to be constructed along the inside face of the exterior embankment (not the embankment which separates cell 1 and 2) for either type of embankment construction. This wave-breaking bench will be constructed to an elevation of 3 feet below the Maximum Surcharge Water Level. The bench will be 25 feet wide on the top, with 1V on 3H side slope. The wave-breaking bench will be constructed from limestone material.

5.3.2.4 Riprap Slope Protection

The interior face of the earthen reservoir embankment will be protected with a 24-inch thick layer of riprap revetment for erosion protection against wave action and water level fluctuation. The material for this riprap will come from blasting the cap-rock layer immediately below the superficial peat-silt layer overlaying the EAA Study Area. In contrast to the embankment fill material, the excavation of the seepage canal is expected to produce the required volume of rock needed for the riprap revetment. The revetment will cover the entire interior face of the embankment from top to bottom, including the wave-breaking bench. A geotextile filter fabric will be placed under the riprap revetment layer.

5.3.3 Pump Station Design

The new pump stations are reservoir inflow structures. The pump stations will capture basin storm runoff, regulatory releases from Lake Okeechobee, and backpump seepage intercepted in the reservoir seepage canals.

Pump sizes were based on flow data for the Miami and North New River Canals. Maximum monthly average flows for the Miami and North New River Canals were obtained from the SFWMD Model (2 x 2) CERP1 model run. Based on the fact that Lake Okeechobee regulatory releases occur over an extended time period, pump stations will have sufficient capacity to fill the reservoirs within a period of 30 days or less. For the final PIR, pump station capacities will be optimized using the sub-regional MIKE SHE model.

5.3.4 Culverts

A one design box culvert structure is considered the best for construction efficiency, operation and maintenance activities, and economics of cost. Therefore, an optimization process resulted in a 10 ft by 10 ft (height vs. width) box culvert structure. The EAA Storage Reservoir design includes numerous gated box culverts. Construction material for all culverts is to be reinforced concrete.

5.3.5 Ogee Spillways

The gated outlet spillways were sized to meet water supply demand in the EAA. Water supply demand in the EAA was estimated to be approximately 2,000 cfs. This value was determined by analyzing historical flow data for the S-351, S-352 structures (outlet structures from Lake Okeechobee into Miami, North New River, and Hillsboro Canals) and the S-6, S-7, and S-8 pump stations. Maximum monthly flow averages were extracted from periods when releases were made from the S-351 and S-352 structures and no flows were made to the WCAs (out of EAA) via the S-6, S-7, and S-8 pump stations. This maximum monthly average flow value was assumed to be the water supply demand in the EAA.

The capacity for the gated outlet spillways to STA-3/4 was based on recommendations from the Basin Specific Feasibility Studies Report (September 17, 2002). Based on this report, the capacity of the outlet spillways was sized to discharge approximately 6,000 cfs. The reservoir outlet spillways to STA-3/4 will discharge into the existing supply canal that is located north of STA-3/4.

5.3.6 Seepage Canals

The seepage canals are located along and parallel to the reservoir's west, north, and eastern boundaries. Seepage canal design information is summarized below in Table 5-7. Seepage rates were based on analyses performed by the Geotechnical Branch. An approximate safety factor of 2.5 was applied for design capacities in recognition of the region's geological irregularities with respect to seepage rates. The seepage canals convey intercepted seepage by gravity flow that may then be backpumped into the reservoirs by the seepage return pumps. The design optimal seepage canal stage and the hydraulic design for seepage canals will be evaluated, optimized and finalized during the project design phase.

TABLE 5-7: SEEPAGE CANAL DESIGN SUMMARY.

Design Parameters	Values
Slope Vertical to Horizontal	1 on 2
Bottom Width (ft)	10
Depth (ft)	16
Littoral Shelf Width (ft)	35
Average Ground El. (ft NGVD)	12

5.3.7 Emergency Overflow Spillway

All alternatives were designed to contain the routed Probable Maximum Flood (PMF) without the use of an emergency overflow spillway. Since this is an overground reservoir the PMF is same as capture of the Probable Maximum Precipitation (PMP) event on the reservoir. Use of an emergency overflow spillway will be investigated and included in the design phase.

5.3.8 Conveyance Canals Design

Back water computations using HEC RAS were performed to determine existing conveyance capacity for the Miami and North New River Canals. Based on these runs, the existing capacities for the Miami and North New River Canals were 3,000 and 2,000 cfs, respectively. Canal conveyance improvements up to 150% were estimated for both the North New River and Miami Canals. Additional conveyance improvements may be necessary to reduce irrigation demands upon Lake Okeechobee. These improvements will be determined through a water budget routings analysis to be performed by the sub-regional Mike-SHE model in the final PIR.

5.3.9 Flood Damage Reduction

The EAA storage reservoirs design will be required to meet the Savings Clause requirements of maintaining existing Level of Service (LOS) for flood protection (see Annex G for results of this evaluation). As previously discussed, any flood protection improvements or benefits that result from the implementation of this Project are considered incidental, and not a specific project goal. The existing flood protection, better described as flood damage reduction, contains a removal rate of ¾-inch per day for the EAA basin. However, removing runoff (untreated agricultural runoff) at this rate is not desirable due to water quality concerns in the WCAs and Lake Okeechobee. By providing 360,000 acre feet of storage capacity that is not currently available, the EAA reservoirs will significantly reduce (though not eliminate) pumping of runoff into Lake Okeechobee flows to the WCAs. The sub-regional MODFLOW model will be the design tool utilized to ensure that the EAA Project meets the Savings Clause requirements for LOS flood projection.

5.3.10 Land Requirements

5.3.10.1 Alternative 2

Approximately 62,000 acres would be required for the Alternative 2. This alternative would use the entire footprint of Compartment A, comprised of approximately 31,500 acres owned by SFWMD. All remaining lands required for

this alternative would be lands between the Miami Canal and North New River Canal, west and north of Compartment A. Of the remaining 30,500 acres required, the SFWMD owns approximately 900 acres and the State of Florida owns approximately 1,520 acres. The remaining lands comprising approximately 28,080 acres would have to be acquired from private interests. A portion of the lands within the alternative were part of the original property of the "Talisman" exchange/acquisition. There are over 35 separate ownerships. It is estimated 20 to 24 parcels would have to be acquired by condemnation.

5.3.10.2 Alternative 3

Approximately 38,000 acres would be required for the Alternative 3. This alternative would use the entire footprint of Compartment A, comprised of approximately 31,500 acres owned by SFWMD. All remaining lands required for this alternative would be lands between the Miami Canal and North New River Canal, west and north of Compartment A. Of the remaining 6,500 acres required, the SFWMD owns approximately 900 acres and the State of Florida owns approximately 1,470 acres. The remaining lands comprising approximately 4,130 acres would have to be acquired from private interests. A portion of the lands within the alternative were part of the original property of the Talisman exchange/acquisition. It is likely all of this approximately 4,130 acres would have to be condemned.

5.3.10.3 Alternatives 4, 5, and 6

Alternatives 4, 5, and 6 are within the footprint of Compartment A, owned by SFWMD and part of the Talisman acquisition.

5.3.10.4 Acquisition and Construction Assumptions

Table 5-8 indicates the results of the varied construction periods, due to land acquisition requirements, of the alternatives.

TABLE 5-8: IMPLEMENTATION ASSUMPTIONS AND SCHEDULE OF CONSTRUCTION.

Alternative	Total Acres	Additional Acres Needed	Land Certification Schedule	Construction Schedule
Alt 2	62,000	30,500	June 2011	Dec 2014
Alt 3	38,000	6,500	June 2009	Dec 2012
Alt 4 and 5	32,000	0	March 2007	Oct 2010
Alt 6	26,500	0	March 2007	Oct 2010

5.3.11 Additional On-Site Management Measures

The following environmental management measures have been developed to provide an increase in spatial extent of natural areas adjacent to or within the EAA storage reservoirs or to ensure that the project will not adversely affect downstream natural areas. Since the final alternative will be selected based upon system-wide benefits, these measures were developed (description, cost, benefits, etc.) to fit any configuration of storage formulated. These environmental management measures are separable elements that provide primarily "local" benefits although they would also contribute to the spatial extent and functional value of various Everglades natural resources. These management measures include:

- Seepage management buffers – areas that would "catch" seepage waters and keep seepage waters from surrounding lands.
- Aquatic deep water refugia – a place that is kept wet during dry down that mobile organisms could use and that would keep a healthy "stock" population (this measure is not intended to add any additional cost to the project).
- Littoral zones – areas around the seepage canals where during high water, vegetation would provide valuable habitat for aquatic species, as well as absorb some of the nutrients.
- Stormwater treatment area (STA) – a water quality treatment area associated with the reservoir to provide treatment of the additional quantity of water to be delivered to the Everglades. The STA could be designed to operate in conjunction with STA 3/4 or as a stand-alone treatment cell. This draft PIR does not include any real estate, engineering, design or construction costs for the proposed stormwater treatment area, which will be included at a Planning level cost estimate in the Final PIR. Current rough order of magnitude costs for the proposed STA include an estimated real estate cost of $8,176,000 and cost estimates for construction ranging from $57,800,000 to in excess of $150,000,000, based on comparative costs of similar construction.

5.3.11.1 Seepage Management Buffers

In an effort to help manage seepage from the EAA Storage Reservoirs, it is recommended that a seepage buffer 200 feet wide be created along the eastern, northern and western exterior levees of the storage reservoirs to improve the function of the seepage canals, and potentially provide a secondary benefit as wildlife habitat. The seepage management buffer will contain a mosaic of naturally vegetated wetland and terrestrial habitats, which offer the optimum habitat for a high diversity of species. The buffer will include a 50-foot wide bench and maintenance area along the toe of the levee to allow for equipment

access during routine maintenance, and the remaining 150 feet will be minimally contoured to create a mosaic of wetland and upland habitat types such as emergent marsh and tree islands. Although wider vegetated wildlife buffers and corridors are usually more desirable and offer increased opportunities for escape cover and nesting sites than narrower buffers, there is no exact width above which wildlife thrives and below which they are nonexistent (Henry, et., al., 1999, Wenger 1999).

The four different depths and configurations considered for the 360,000 acre-foot reservoirs result in varying seepage buffer acreage. Based on a buffer width of 200 feet, Alternatives 2 through 6 would allow buffers ranging from about 450 to 760 acres. These buffers would serve as natural transition zones, provide habitat for wildlife, and provide essential life support for amphibian and reptile species (USFWS and FWC 2004). The wetland portion of the buffer will be hydrated by water seeping from the reservoirs and will provide habitat for a variety of aquatic species and wading birds. The tree island portion of the buffer will also provide habitat for wildlife including nesting and roosting habitat for species using the adjacent reservoir and buffer area wetlands. Buffers also serve as important wildlife travel corridors and safety barriers between constructed features and developed or agricultural areas.

The importance of wetlands in South Florida has been documented and it is known that undesirable changes and substantial losses have occurred over the last century. Wetland gains are linked to: 1) increased wildlife diversity and abundance; 2) improved water quality; 3) increased water storage capacity; 4) enhanced downstream functions of the natural environment; and, 5) improved human interests. Helping to reverse the historic trend of wetland losses by gains in wetland acreage and quality would be a significant achievement.

5.3.11.2 Deep Water Refugia

Even though the storage reservoirs will be designed to hold and retain at least some amount of water at all times, there may be times of extreme drought in which it will more than likely dry out. Deep water refugia are areas within a reservoir that are deep enough to maintain some standing water, at least 3 or 4 feet in depth, when the rest of the reservoir dries out.

Deep water refugia would significantly reduce mortality of and provide important habitat for aquatic wildlife during periods of dry-out. They would act as an important "seed source" of aquatic organisms for when the reservoirs become rehydrated. They would also provide temporary feeding grounds for wading birds while the rest of the reservoir is dry.

5.3.11.3 Littoral Shelves

Littoral shelves are shallow-water areas around the shorelines of the seepage canals where sunlight usually penetrates to the bottom. Aquatic vegetation, such as emergent and submergent plants, can grow in these areas. Not only would littoral shelves and their associated vegetation provide excellent aquatic habitat for fish and other aquatic organisms, they would also provide water quality improvements due to the removal of nutrients by the vegetation, and increase recreational opportunities, such as fishing. The littoral shelves would be constructed by scraping down the peat layer.

5.3.11.4 Stormwater Treatment Area (STA)

Operation of the EAA Storage Reservoir project involves capturing and storing regulatory releases from Lake Okeechobee and runoff from the Everglades Agricultural Area and subsequently delivering the stored water for to the Everglades Agricultural Area and to meet hydrologic targets in the Water Conservation Areas (WCAs) and Everglades National Park (ENP). Although the alternative plans work in concert with STA 3/4, it is anticipated that the additional hydraulic and phosphorus loading associated with delivering additional water to the WCAs and Everglades National Park to meet hydrologic targets will occasionally exceed the treatment capacity of STA 3/4.

To ensure that water that is to be delivered to the WCAs and Everglades National Park meets water quality requirements, a conceptual STA is included as an additional on-site management measure. Additional analysis will be conducted prior to the Final PIR and during the detailed engineering and design phase of the project to refine the design, cost, and operations of this STA. The optimization of the proposed STA may include utilizing a portion of Cell 2 of the reservoir for water quality treatment.

5.3.12 Costs of Alternative Plans and Components

Construction cost estimates for the various alternatives were made in the Micro-Computer Aided Cost Estimating System software (MCACES) version 5.31. The basis of the cost estimates was the scope of work provided by the engineering technical lead. The scope of work provided a layout of the plan features, a description of the major feature's special considerations, quantity calculations, and specific reference to particular structures. Cost estimates for culvert spillways, culvert structures, and pump plants were produced in cost models from quantities provided. The final alternate costs were produced in spreadsheet format by extending the unit cost produced in MCACES by quantities provided in Table 5-9. Additional costs for water quality monitoring, recreation features, and operations and maintenance of recreation features have been developed and

are equal for all alternative plans, these costs will only be included the costs of the selected alternative plan (Section 6).

TABLE 5-9: ALTERNATIVE PLAN COST ESTIMATES.

	EARTHEN EMBANKMENT LEVEES				RCC
	Alternative 2	Alternative 3	Alternative 4	Alternative 6	Alternative 5
Borrow and Canal	$270,336,727	$246,263,659	$261,957,593	$301,143,945	$124,001,000
Levee construction	$174,937,875	$165,977,864	$191,732,312	$191,593,171	$296,594,000
Cutoff Wall	$19,031,423	$40,873,427	$86,086,678	$87,729,623	$122,690,000
Utility Relocations	$323,857	$323,857	$323,857	$323,857	$323,857
Bridges	$5,903,208	$5,903,208	$5,636,497	$5,636,497	$5,636,497
NNR Canal Improvements	$38,987,754	$31,190,561	$35,443,519	$34,025,720	$35,443,519
Miami Canal Improvements	$29,013,275	$34,090,418	$16,682,354	$15,957,273	$16,682,354
Bolles & Cross Improvements	$20,432,385	$20,745,203	$20,745,203	$20,745,203	$20,745,203
Pump Stations	$115,441,032	$108,352,882	$122,520,842	$132,402,279	$122,520,842
Structures	$17,116,634	$14,714,934	$14,664,934	$14,664,934	$14,714,934
Manatee Gates	$5,375,000	$5,375,000	$5,375,000	$5,375,000	$5,375,000
Total Construction Cost	$696,899,170	$673,811,013	$761,168,789	$809,597,502	$764,727,206
Real Estate	$329,739,000	$115,313,000	$80,134,000	$67,426,000	$80,134,000
S&A	$33,750,000	$33,750,000	$33,750,000	$33,750,000	$33,750,000
PED	$37,500,000	$37,500,000	$37,500,000	$37,500,000	$37,500,000
Total Estimated Cost	$1,098,150,988	$900,478,130	$912,552,789	$944,976,691	$916,061,206

5.3.12.1 Calculation of Average Annual Cost

Data for initial construction/implementation, land acquisition, monitoring, and periodically recurring costs for OMRR&R (operation, maintenance, repair, replacement, and rehabilitation), have been developed through engineering design and cost estimation, and real estate appraisal efforts. Details of that data development are explained and discussed elsewhere in this report. For economic evaluation of alternative plans on a comparable basis, these cost estimates are further refined through present worth calculations, use of appropriate price levels, and consideration of the timing of project expenditures.

Costs represent the difference between conditions without any plan (the without project condition) and conditions with an alternative plan. For purposes of this report and analysis, NED costs (National Economic Development Costs, as defined by Federal and Corps of Engineers policy), are expressed in 2005 price levels based on costs estimated to be incurred over a 39-year period of analysis. Costs of a plan represent the value of goods and services required to implement, operate, and maintain the plan.

The timing of when a plan's costs are incurred is important. Construction and other initial implementation costs cannot simply be added to periodically recurring costs for project operation, maintenance, and monitoring. Also, construction costs incurred in a given year of the Project can't simply be added to construction costs incurred in other years if meaningful and direct comparisons of the costs of the different alternatives are to be made. A common practice of equating sums of money across time with their equivalent at an earlier single point in time is the process known as discounting. Through this mathematical process, which involves the use of an interest rate (or discount rate) officially prescribed by Federal policy for use in water resource planning analysis (currently set at 5.125% per year), the cost time streams of each alternative are mathematically translated into a present worth value. This present worth value, calculated for this study as of the beginning of the period of analysis (2011), can then be directly and meaningfully compared between the plans being considered in this study. An annual value, equivalent to the present worth, can also be computed for the 39-year period of analysis. This average annual value represents an equivalent way of expressing the costs of a plan. The various costs estimated to be incurred over time to put each plan into place and operating have been computed and expressed as both a present worth value and an average annual equivalent value. USACE Engineering Regulation 1105-2-100 requires that average annual equivalent costs be used for cost-effectiveness and incremental cost analyses (CE/ICA).

In general, since all the alternatives provide 360,000 acre-feet of storage, the difference in costs for the various alternatives are due to different real estate

costs (because of varying land area requirements, i.e., alternative "footprints", and time required for land acquisition), varying material and operational costs, and varying interest during construction (IDC) costs. Construction, real estate, IDC, total investment, present worth, and average annual equivalent costs for the EAA alternatives are presented in Table 5-10.

TABLE 5-10: CALCULATION OF COSTS USED IN COST-EFFECTIVENESS ANALYSIS ($1000).

COST Component	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Lands	$329,739	$115,313	$80,134	$80,134	$67,426
Construction	$768,149	$745,061	$832,419	$835,977	$880,848
Total First Cost	$1,097,888	$860,374	$912,553	$916,111	$948,274
IDC Construction	$71,281	$69,138	$77,244	$77,575	$81,738
IDC Real Estate	$67,972	$23,771	$16,519	$16,519	$13,899
Total Investment	$1,237,141	$953,283	$1,006,316	$1,010,205	$1,043,911
Annual Equivalent	$60,534	$51,548	$60,136	$60,369	$62,383
O&M (annual)	$2,665	$2,287	$2,409	$2,286	$2,322
Total Average Annual Cost	$63,199	$53,835	$62,545	$62,655	$64,705

5.3.12.2 Earthwork Cost Estimates

The earthwork cost estimates for levees, canals, berms, swales, and other general earthwork, used standard construction techniques and standard equipment. The cost estimates for this work relied on equipment manufacturers' data. The haul distances for trucking operations were approximations based on general assumption about the location of borrow areas. The cost estimates relied on data provided by designers for quantity estimates of cut and fill, suitable and unsuitable material, rock and overburden, and swell and compaction factors.

5.3.12.3 Pump Plant Cost Estimates

Pump plant cost estimates were produced by incorporating data provided by designers relating to pump capacity, number of pumps, concrete quantity,

station dimensions, and dewatering plan. The data served as the basis for modifying a standard cost estimate for a pump plant of the same type. The particular standard pump plant cost estimate was derived from the government estimate of cost and the contract cost for a pump plan under construction or recently completed.

5.3.12.4 RCC Cost Estimates

Construction cost estimates for RCC were produced by incorporating data provided by designers. The data provided RCC quantity, wave break quantity, and foundation treatment quantities. The cost estimates incorporate assumptions regarding haul distances for processed material, material processing, the mix design, and distribution and compaction of the RCC.

5.3.12.5 Cut-Off Wall

Cut-off wall estimates were developed from information provided about length and depth. The developed cost estimate relies on assumptions about mix design, excavation techniques, method of wall construction, and capping technique.

5.3.12.6 Other Structures

Other structures (overflow weir, spillways) had cost estimates developed from MCACES cost data, recent material quotes, and historical data. The basis of the cost estimates were general descriptions of the structure and required capacity.

5.3.12.7 Planning, Engineering and Design

Planning, engineering, and design costs were estimated by the various engineering team members and provided for inclusion in the cost estimate.

5.3.12.8 Construction Management

Construction management costs were estimated by the Construction Operations Division.

5.3.12.9 Contingency

A construction contingency of 25% of construction cost was used for all construction other than the pump plant where a contingency of 15% of construction cost was used. No statistical analysis of cost risk was performed. The major factors influencing the construction contingency cost are:

- The estimate of rock quantity and usable material percentage: The rock elevations were provided and were based on available borings data.

Normal variations are expected as the subsurface investigations are made.

- Haul distances for trucking operations: Haul distances were analyzed to identify reasonable areas with the required carrying capacity. Normal variances are expected in routing.
- The structure construction quantities: The structure quantities were calculated from standard designs. Normal variations are expected in site-specific designs.
- The levee and canal alignments and cross-sections: A change that could affect quantity was not anticipated. Normal design variances are expected as more specific site data is acquired.

5.3.12.10 Real Estate Cost Estimates

Real Estate cost estimates were provided and estimated by the various real estate team members and provided for inclusion in the cost estimate. The real estate cost estimates were based on SFWMD's actual acquisition costs and actual administrative costs for lands owned by SFWMD, and the estimated acquisition and administrative costs which would be incurred during acquisition of lands owned the State of Florida and private interests.

Approximately 1,495 acres of land already owned by the State of Florida and the South Florida Water Management District adjacent to and in the west corner of the reservoir have been identified as the likely site for the proposed STA. Estimated real estate cost for 1,495 acres of land is $8,176,000. Real estate and other cost estimates for the construction and operation of the proposed STA are not included at this time in the Total Annual Average Costs since the STA is conceptual in nature. Additional analysis will be conducted prior to the Final PIR and possibly during the detailed engineering and design phase of the project to refine the design, cost, and operations of this stormwater treatment area.

5.4 COMPARING ENVIRONMENTAL EFFECTS AND PROJECT COSTS OF ALTERNATIVE PLANS

5.4.1 Environmental Effects

Effects of the alternatives on natural and cultural resources are displayed in Table 5-11. Additional information regarding the different alternatives is given in Appendix C. A more thorough discussion of the environmental effects on the Selected Alternative Plan can be found in Section 7.

TABLE 5-11: EFFECTS EVALUATION: CATEGORIES OF NATURAL AND CULTURAL RESOURCES EFFECTS

Categories of Effects	Existing Condition	Alternative 1 "No Action" (Future without project)	Alternative 2 360k ac-ft reservoir with 6' max depth	Alternative 3 360k ac-ft reservoir with 10' max depth	Alternative 4 360k ac-ft reservoir with 12' max depth (Earthen)—Selected Alternative Plan	Alternative 5 360k ac-ft reservoir with 12' max depth (RCC)	Alternative 6 360k ac-ft reservoir with 14' max depth
Soils (Prime and Unique Farmland)	0 acres	0 acres	62,000 acres	38,000 acres	32,000 acres	32,000 acres	26,500 acres
Groundwater	Good	Slight effect; increasing population may decrease surficial aquifer	Minor benefit	Minor benefit	Minor benefit—may provide additional source of recharge	Minor benefit—may provide additional source of recharge	Minor benefit—may provide additional source of recharge
Air Quality	Good	Good	Minor adverse effects from pumps	Minor adverse effects from pumps	Minor adverse effects from pumps	Minor adverse effects from pumps	Minor adverse effects from pumps
Noise	Low noise (34-55 decibels)	No change	Temporary rise in noise levels from construction	Temporary rise in noise levels from construction	Temporary rise in noise levels from construction	Temporary rise in noise levels from construction	Temporary rise in noise levels from construction
Natural wetlands	Pockets of remnant wetlands; fair quality, moderate exotics	No change	359 acres of existing wetlands lost	220 acres existing wetlands lost	206 acres existing wetlands lost	206 acres existing wetlands lost	206 acres existing wetlands lost
Fish and Wildlife Habitat	Mostly agricultural land; canals provide aquatic habitat	No change	~60,000 ac of aquatic habitat; seepage buffer provides wetland/upland mosaic; earthen levee provides upland habitat	~37,000 ac of aquatic habitat; seepage buffer provides wetland/upland mosaic; earthen levee provides upland habitat	~31,000 ac of aquatic habitat; seepage buffer provides wetland/upland mosaic; earthen levee provides upland habitat	~31,000 ac of aquatic habitat; seepage buffer provides wetland/upland mosaic; RCC provides no habitat	~26,000 ac of aquatic habitat; seepage buffer provides wetland/upland mosaic; earthen levee provides upland habitat

Threatened and Endangered Species	15 species; 1 critical habitat	15 species; 1 critical habitat; Lake and estuarine habitat quality may degrade	Benefit recovery of snail kite, smalltooth sawfish, opossum pipefish, Johnson's seagrass; loss of 60,000 ac of potential panther habitat	Benefit recovery of snail kite, smalltooth sawfish, opossum pipefish, Johnson's seagrass; loss of 37,000 ac of potential panther habitat	Benefit recovery of snail kite, smalltooth sawfish, opossum pipefish, Johnson's seagrass; loss of 31,000 ac of potential panther habitat	Benefit recovery of snail kite, smalltooth sawfish, opossum pipefish, Johnson's seagrass; loss of 31,000 ac of potential panther habitat	Benefit recovery of snail kite, smalltooth sawfish, opossum pipefish, Johnson's seagrass; loss of 26,000 ac of potential panther habitat
Water Quality	Varies between poor to good in different geographic regions; some areas have high levels of nutrients and/or pesticides; high number of Lake regulatory releases	Some improvement in water quality to Everglades from ECP STAs	Increase efficiency of STAs; reduce number of Lake regulatory releases to the estuaries; may have frequent reservoir drydowns	Increase efficiency of STAs; reduce number of Lake regulatory releases to the estuaries; may have moderate reservoir drydowns	Increase efficiency of STAs; reduce number of Lake regulatory releases to the estuaries; may have few reservoir drydowns	Increase efficiency of STAs; reduce number of Lake regulatory releases to the estuaries; may have few reservoir drydowns	Increase efficiency of STAs; reduce number of Lake regulatory releases to the estuaries; reservoir drydowns minimal
Cultural Resources	No significant cultural resources found in Compartment A	No change	Cultural resources survey of additional land may be necessary	Cultural resources survey of additional land may be necessary	Not applicable for reservoir site; cultural resources survey of Miami and NNR canals pending	Not applicable for reservoir site; cultural resources survey of Miami and NNR canals pending	Not applicable for reservoir site; cultural resources survey of Miami and NNR canals pending
Irreversible and Irretrievable Commitments of Resources	None	None	62,000 acres converted to reservoir; fish and wildlife habitat permanently altered to mostly aquatic; significant amount of limestone used for reservoir construction	38,000 acres converted to reservoir; fish and wildlife habitat permanently altered to mostly aquatic; significant amount of limestone used for reservoir construction	32,000 acres converted to reservoir; fish and wildlife habitat permanently altered to mostly aquatic; significant amount of limestone used for reservoir construction	32,000 acres converted to reservoir; fish and wildlife habitat permanently altered to mostly aquatic; moderate amount of limestone used for reservoir construction	26,500 acres converted to reservoir; fish and wildlife habitat permanently altered to mostly aquatic; large amount of limestone used for reservoir construction

5.4.1.1 Fish and Wildlife

All wildlife sightings listed in Table 2-7 document wildlife observations for Compartment A. They were based on direct observations by an interagency field team evaluating wetlands in the EAA. As such, the compiled list is skewed toward wetland dependent species even though this type habitat is relatively scarce. In addition, Alternative 2 and Alternative 3 reservoir footprints contain significant areas outside Compartment A that were not visited; however, the habitats are similar to that observed within Compartment A. Therefore, it is assumed that resident, transient, and migratory wildlife utilizing this area will be similar to those in Component A.

5.4.1.2 Water Quality

The EAA Storage Reservoir project is expected to improve water quality conditions in the Study Area, as well as in Lake Okeechobee, the Caloosahatchee Estuary, the St. Lucie Estuary, and the EPA. The proposed storage reservoirs would reduce pollution loading into downstream receiving water bodies through the attenuation of surface flows and reduction of associated pollutant loads prior to discharge.

Steady-state modeling was performed to examine the water quality effects of the reservoir. For this analysis, pollutant removal and outflow concentration were determined primarily for total phosphorus. Total phosphorus was examined in detail, because of its place as the pollutant of primary concern. The design inflow rates were taken from the SFWMM simulation output. Detailed analyses can be found in the Water Quality Assessment Report in Appendix F. The metering of water from the proposed storage reservoir into the STAs would allow them to consistently improve water quality before release to the EPA.

The four alternatives are all expected to have a significant positive impact upon water quality released to STA3/4. Alternatves 4 & 5 produce the lowest total phosphorus concentration. A reservoir is expected to also provide some improvement in water quality for other nutrients, metals, and pesticides/herbicides.

5.4.1.3 Socioeconomics

Project alternatives were analyzed for potential social and economic impacts. Social and/or economic impacts that could occur are the following:

a) Induced substantial population growth;
b) Displaced on-site population;
c) Substantial employment losses; and,
d) Increased demand on community services causing service level reductions.

Construction and operation of the alternatives could cause social and economic impacts, however, the alternatives will not have significant direct or indirect effects on population within the EAA or the South Florida region as measured by displaced population from Compartment A and induced population growth.

The conversion to reservoirs will eliminate the production value of sugarcane and other crops. Table 5-12 below shows the acreage of certain crops that would be converted with a particular alternative (Water & Air Research, 2005).

TABLE 5-12: AREA CONVERTED FROM CROPS TO RESERVOIRS.

Crops	Alternative 2 (acres)	Alternative 3 (acres)	Alternatives 4 and 5 (acres)	Alternative 6 (acres)
Sugarcane	47,628	28,423	23,635	19,706
Row crops	620	620	620	620
Other agricultural	302	180	141	165

At any given time, a sugarcane farm will have 25% devoted to planting, 25% first ratoon, 25% second ratoon, 12.5% fallow, and 12.5% in roads, canals, and ditches. In 2002, Palm Beach County had 328,000 harvested acres of sugarcane, yielding 39.5 tons/acre, and producing 12,851,000 tons. Average price per ton in the U.S. in 2002 was $28.40, yielding an approximate value of sugarcane production in Palm Beach County of $364 million. Table 5-13 below shows the comparison between the different alternatives in terms of lost sugarcane production and the percentage of 2002 Palm Beach County sugarcane production lost.

TABLE 5-13: COMPARISON OF SUGARCANE PRODUCTION LOST.

Production	Alternative 2	Alternative 3	Alternatives 4 and 5	Alternative 6
Sugarcane harvested	933,000 tons	557,000 tons	463,000 tons	386,000 tons
Value of harvest	26.5 million	$15.8 million	$13.1 million	$11.0 million
% total value	7.3%	4.3%	3.6%	3.0%

5.4.2 Environmental Benefits

Because CERP projects are required to be selected and justified based on their system-wide benefits, the evaluation process was based on the system-wide performance measures developed by the Restoration Coordination and Verification (RECOVER) team. This project is expected to primarily benefit the following areas: Lake Okeechobee littoral zone, St. Lucie Estuary, Caloosahatchee Estuary, and the Greater Everglades (WCAs 2, 3, and Everglades National Park). Below are detailed descriptions of the benefits to

each region. In addition to system-wide performance measures, an evaluation methodology was developed to capture localized alternative effects.

5.4.2.1 Quantification of Ecological Benefits Methodology

A method was developed and used to evaluate project alternatives and quantify ecological benefits associated with the alternative plans. The method produced quantitative output that allowed the study team to compare ecosystem benefits across all alternatives. The method used performance measures developed and agreed upon by the study team and RECOVER. These performance measures have quantifiable and well-defined targets, and tools available to predict performance. The evaluation method was developed to be as simple as possible, readily understandable, and agreeable to all parties and participants involved with the Project.

5.4.2.1.1 Division of Project Area into Regions

Most of the ecological benefits to be derived from this Project are expected to occur on a system-wide level. To facilitate quantifying ecological benefits, the Project area was divided into four major ecologic zones based on general ecological characteristics unique to each region. These ecologic zones include: 1) Lake Okeechobee, 2) St. Lucie Estuary, 3) Caloosahatchee Estuary, and, 4) the Greater Everglades (WCAs 2, 3, and Everglades National Park).

5.4.2.1.2 Performance Measure Assessment Methodology

This methodology provided a framework for quantifying ecological benefits for project alternatives. Benefits were quantified as an ecological benefits index by aggregating all performance measure values applicable to a given ecological zone into a single equation, yielding a single benefits value similar to the Hydrogeomorphic Method (Smith, et. al., 1995; Smith and Wakeley 2001). This approach allowed a convenient means for weighting performance measures and provided a process for removing bias that could be incurred from correlated (i.e., dependent) performance measures. Finally, the process provided the capability of converting the ecological index values into Habitat Units.

5.4.2.1.3 Use of EAA Storage Reservoirs Performance Measures

Initially, a total of 14 system-wide performance measures were selected for this Project from applicable performance measures from the CERP Regional Evaluation Team (RET). The performance measures were limited to those that might show differences between with and without project conditions and were refined to increase the sensitivity of the model output. All of the performance measures used hydrologic targets. To make the correlation between hydrologic output and ecosystem functions, the Ecological Sub-team used the Conceptual

Ecological Models developed for each region by the RECOVER team as well as information contained within the performance measure documentation sheets. Each one the performance measures addressed one of the specific project objectives. For example, one of the performance measures entitled, "Lake Okeechobee Extreme High Stage" addressed the stated project objective of "Habitat Improvement of Lake Okeechobee."

TABLE 5-14: RECOVER PERFORMANCE MEASURES USED FOR EAA STORAGE RESERVOIRS PROJECT.

PM	Project Objective	Performance Measure	Target
LO-E3	Habitat improvement of Lake Okeechobee	Lake Okeechobee Extreme High Lake Stage	No events above 17 feet
LO-E10	Habitat improvement of Lake Okeechobee	Lake Okeechobee Stage Envelope	Minimize deviation from stage envelope (less than 192 feet-weeks)
NE-E1	Habitat improvement of St. Lucie Estuary	St. Lucie Salinity Envelope	Low flow target less than 350 cfs for 207 months No Lake Okeechobee regulatory discharges No more than 21 months of mean monthly flows between 2000-3000 cfs No more than 12 months of mean monthly flows of greater than 3000 cfs
NE-E3	Habitat improvement of Caloosahatchee Estuary	Caloosahatchee Estuary Salinity Envelope	Freshwater discharges from the C-43 canal at S-79 to be maintained between 300-2800 cfs <70 months with mean monthly flow <300 cfs; months with low flow should occur in the dry season (Nov-May) <7 months with mean monthly flows >4500 cfs
GE-E2	Habitat improvement of the Everglades Protection Area	Inundation Pattern in the Greater Everglades Wetlands	NSM 4.6 envelope for number of inundation events and mean duration in weeks of each event for each indicator region
GE-E3	Habitat improvement of the Everglades Protection Area	Extreme High and Low Events in the Greater Everglades Wetlands	NSM 4.6 envelope for extreme high and low events and the number and mean duration in weeks of high and low events for each indicator region
GE-E6	Habitat improvement of the Everglades Protection Area	Species Richness Suitability for Everglades Tree Islands	NSM 4.6 envelope for hydroperiod of tree islands for each indicator region

For purposes of this analysis, all applicable performance measures for a given geographic region were used when possible. The SFWMM provided the output

for all the performance measures used. The uncertainty regarding the ability of SFWMM to show differences among alternatives may be found in the Risk and Uncertainty section. After examining the model output, the Ecological Sub-team decided upon a final subset of nine performance measures that best encompasses and reflects project objectives to quantify ecological output. These system-wide performance measures are quantifiable, predictive, and possess environmental outputs capable of evaluating differences and benefits between alternatives. They have the greatest potential of being used in the alternative evaluation and selection process. Table 5-14 displays the performance measures, associated targets, and the associated project objectives. Detailed information regarding performance measure descriptions, targets, justifications, current conditions, and evaluation methods may be found in the RET performance measure documentation sheets (USACE, 2004b).

Besides the RECOVER performance measures, two other performance measures were developed to capture water quality benefits to the lake and the greater everglades: backpumping volume to Lake Okeechobee and STA bypass volume, respectively. The target for both of these performance measures is to minimize the volume of water that is backpumped to the lake and the volume of water that bypasses STA-3/4.

5.4.2.1.4 Predictive Evaluation Tools and Operational Assumptions

Like many other CERP projects, the Natural Systems Model (NSM) has been used to characterize pre-drainage conditions in the Project area. The operational assumptions used as input into the SFWMM runs include the current WSE for Lake Okeechobee regarding regulatory releases from the lake. For the existing and future without project conditions, the water from the lake regulatory releases is sent to tide through the St. Lucie and Caloosahatchee Estuaries, and runoff water from the agricultural area is released to the WCAs.

For the with project condition, once the lake stage goes higher than a certain stage, water is released first to the reservoirs (cell 2); if the lake stage continues to go beyond an upper limit stage, then water would be released to tide.

As the reservoir stage increases in response to receiving water from Lake Okeechobee and/or from surrounding agricultural runoff, it is possible to intentionally deliver water to downstream natural areas via STA-3/4 in response to downstream environmental demands, or to local agricultural stakeholders to help meet water supply demands that would otherwise be met via deliveries of water from the regional water management system. In addition to planned releases, it is anticipated that there will be periods during which releases from the reservoir will be necessary to maintain reservoir stages at safe/acceptable levels and/or in preparation for storm events. As a guiding principle, it is

intended that the reservoir will be operated in a manner consistent with restoring and/or sustaining hydrologic conditions in natural areas necessary to protect fish and wildlife.

5.4.2.1.4.1 Operations under Existing Conditions (Start-up Operations)

It is recognized that the timing and volumes of deliveries from the reservoir to downstream natural areas could be affected by many existing operational and structural constraints of the regional water management system. Many constraints are planned to be reduced and/or eliminated by the time the EAA Reservoir becomes operational. If the EAA Reservoir is completed prior to the scheduled completion date presented in this document, it is possible that the operation of the reservoir will be constrained by some existing operational and structural constraints. Examples of such potential constraints include limitations imposed by downstream structure capacities, and special water management operations tailored toward yielding very specific hydrologic conditions during specific periods of the year.

Until such time that additional water can be delivered in a manner consistent with restoring and/or sustaining hydrologic conditions necessary to protect fish and wildlife, total volumes of water made available by the EAA Reservoir project for introduction to the Everglades Protection Area are likely to remain near existing levels. If existing constraints still exist upon completion of construction, it is intended that the reservoir will be operated in the presence of existing constraints:

- to receive water from Lake Okeechobee and/or from surrounding agricultural runoff;
- to deliver water from the reservoir to downstream natural areas via STA-3/4 during the dry season, only at times of natural system need; and
- to deliver water from the reservoir to meet local agricultural water supply demands that would otherwise be met via deliveries from the regional water management system.

In addition to planned releases, it is anticipated that there will be periods during which releases from the reservoir will be necessary to maintain reservoir stages at safe/acceptable levels and/or in preparation for storm events.

The benefits quantified below are based on conditions that are consistent with the preliminary operations characterized above.

5.4.2.1.4.2 Operations under Future Conditions (Future Operations)

It is anticipated/planned that projects such as the Modified Water Deliveries to Everglades National Park Project will have reduced and/or eliminated many existing operational and structural constraints by the time the EAA Reservoir Project becomes operational. Consistent with the general operational intent of the EAA Reservoir, it is intended that the reservoir will be operated in a manner consistent with restoring and/or sustaining hydrologic conditions necessary to protect fish and wildlife. Toward that end, it is intended that the reservoir will be operated in the absence of existing constraints:

- to receive water from Lake Okeechobee and/or from surrounding agricultural runoff;
- to deliver water from the reservoir to downstream natural areas via STA-3/4 during the wet and dry seasons in a manner consistent with stage and/or volume-based restoration targets; and
- to deliver water from the reservoir to meet local agricultural water supply demands that would otherwise be met via deliveries from the regional water management system.

Once existing constraints on operations are reduced and/or eliminated such that additional water could be delivered in a manner consistent with restoration goals, total volumes of water made available by the EAA Reservoir project for introduction to the Everglades Protection Area are anticipated to be greater than existing levels. Such deliveries will be released to the Everglades Protection Area by way of STA-3/4. Because the volumes of water to be delivered to the Everglades Protection Area are likely to increase in the future and/or as more CERP projects are constructed, it is possible that additional STA optimization and/or capacity might be required to handle the additional hydraulic and nutrient loading rates associated with CERP-like deliveries. The potential need for additional STA optimization and/or capacity is being investigated.

5.4.2.1.5 Quantifying Performance Measures

Where possible, performance measure targets and scores were converted into a standardized scale of ecosystem conditions on a 0.1-1 scale and used in aggregation equations. The framework for ecosystem condition benchmarks could be presented as indicated below (Table 5-15):

The Indian River Lagoon South Project used such a system to convert certain performance measure values from a raw score or percent target achieved to ecosystem condition, or "quality values." The quality values were defined based on known ecological principles for the potential effects of the project performance measures. The "quality" factor applied in subsequent calculations was a measure of the quality of the resource, as applied to a specific restoration objective.

TABLE 5-15: FRAMEWORK FOR ECOSYSTEM CONDITION BENCHMARKS

Score	Condition
0.9-1.0	Fully restored
0.8-0.9	Mostly restored
0.6-0.8	Functional and sustainable
0.4-0.6	Minimally sustainable
0.2-0.4	Declining
0.01-0.2	Fully degraded

After each performance measure was quantified for a given ecological region, an ecological benefits index was calculated for that region by aggregating the performance measure values into an equation to produce a single ecological benefits index value for the region. This provided a means for addressing non-independence between performance measures and allowed a means for weighting more important performance measures. The approach is similar to what is used in the Hydrogeomorphic Method (HGM) for wetland assessment models (Smith, et. al., 1995; Smith and Wakeley 2001). With HGM, these equations are used to derive functional capacity indices for evaluating wetlands. The same approach can be used to derive a single evaluation or benefits value for a given alternative based on all of the performance measures applicable to a given ecological region. By applying various mathematical functions to the equation, the approach provides a means for addressing correlated performance measures and adjusting performance measure weighting factors. Thus, interactions that may exist between and among performance measures can be addressed. The weighting factors applied are for descriptive purposes only, and should not be construed as a final weighting. The same applies for how correlated performance measures are handled. The justification for any and all weighting that may be conducted in the analysis should be documented in detail. Factors that should be considered when determining performance measure weighting include uncertainty in hydrologic metrics, degree of development, calibration, and validation of the PM, degree of justification based on the best available scientific research, and importance of the PM as an indicator in shaping the ecosystem.

The equation below provides an example for performance measures that apply to Lake Okeechobee. If we assume that each is independent of one another, and all are equally weighted, an ecological benefits index for the lake (EBILO) can be calculated by aggregating the individual performance measures into an equation as follows:

EBILO = (QILO-E3 + QILO -E10)/2

where QILO -E3 and QILO-E10 refer to Lake Okeechobee stages quality index values.

As another step, the mean ecological benefits index (MEBI) may be calculated by adding up the ecological index values for the lake, estuaries, and Greater Everglades and dividing by four:

MEBI = (EBILO + EBISLE + EBICE + EBIGE)/4

This equation assumes that all four ecological regions are equally important, and thus equally weighted.

The two water quality performance measures, backpumping and bypass, did not lend themselves to having the raw data converted to a quality value due to the uncertainty in correlating the raw data to a particular type of habitat. For those two performance measures, volume of water was directly used to compare the alternatives.

5.4.2.2 Summary of Annualized Benefits

The following sub-sections describe the annualized ecological benefits to the four geographic regions. As previously described, ecological benefit index scores for each region were multiplied by the acreage of the affected area to obtain Habitat Units.

5.4.2.2.1 Lake Okeechobee

The Project shows a clear improvement in high water conditions for Lake Okeechobee compared to the future-without-project condition (Figure 5-7). The step-wise trend for the 360,000 acre-feet-with-all-CERP reflects the effects of other CERP storage projects coming on-line according to the MISP. Benefits for Alternative 2 and 3 begin later than for the rest of the plans due to the additional time to acquire more lands. The project provides no measurable improvement in low water conditions in Lake Okeechobee.

The Project shows a reduction in backpumping volumes from the EAA into Lake Okeechobee through the S-2 and S-3 structures compared to the future without project condition. This decrease in volume of water between future without project and with the project is 1,328,898 acre-feet (with-CERP analysis). While the ecological benefits for this reduction are difficult to define, the decrease in backpumping will reduce nutrient, trace metal, and pesticide loading to the lake, thereby improving the overall habitat. In looking at sensitivity runs of the SFWMM, the team noted a direct relationship between increasing the reservoir storage volume with the reduction of backpumping to the lake.

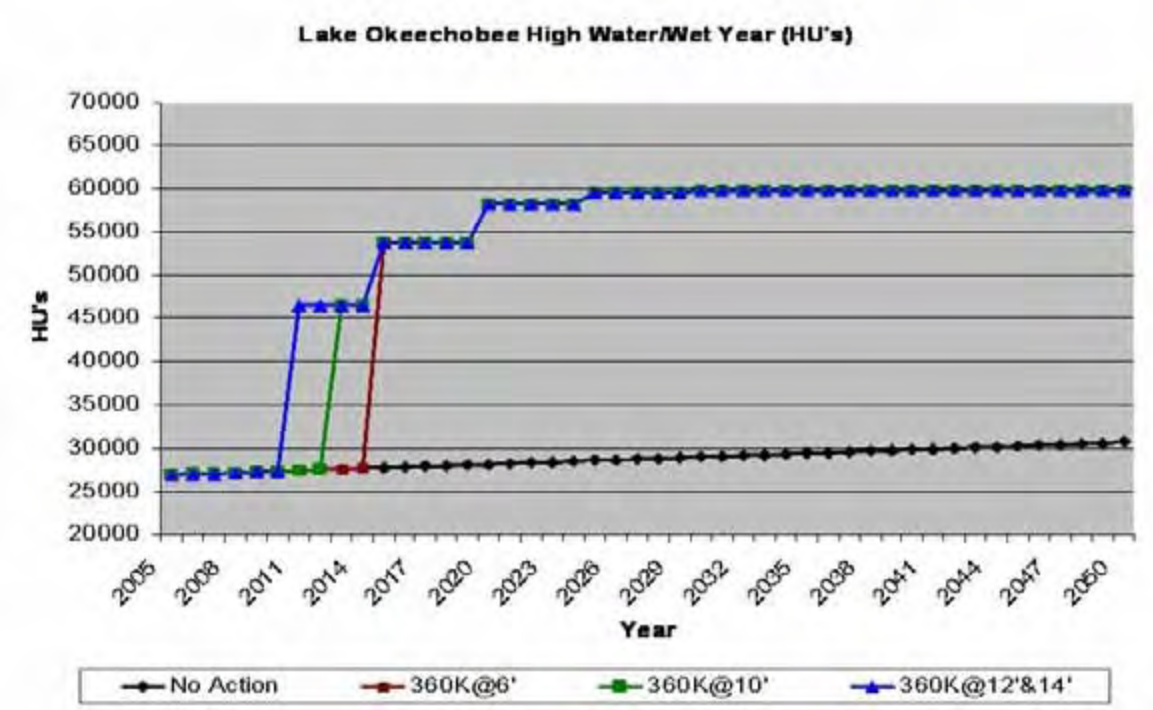

FIGURE 5-7: ECOLOGICAL BENEFITS FOR LAKE OKEECHOBEE.

The affected area for the lake is the littoral zone, which consists of approximately 96,000 acres.

5.4.2.2.2 St. Lucie Estuary

The performance measure for the salinity envelope for the St. Lucie Estuary has four targets dealing with flows into the estuary. The only target the Project does not successfully reach is flows less than 350 cfs for at least 207 months out of the 36-year period of record, with a with-CERP score of 0.66. The model output did show the Project has a significant benefit in regard to the number of regulatory releases from Lake Okeechobee. This benefit is seen in Figure 5-8. As in Lake Okeechobee, the benefits for Alternatives 2 and 3 are delayed compared to the other alternatives. The saw tooth pattern depicted in all the alternatives, including the future without project, is due to the periodic high regulatory releases from Lake Okeechobee, which have detrimental effects on the estuary. For the with-CERP analysis, this saw tooth pattern is combined with the onset of other CERP water storage projects. Once all the CERP projects come on-line, we expect no further detrimental regulatory releases from the lake. While this project alone cannot achieve full restoration of the estuary, it does provide significant improvement for the 922 affected acres by greatly reducing the number of regulatory releases, which has shown to be damaging to the submerged aquatic vegetation, oysters, fish, and other fauna within that habitat.

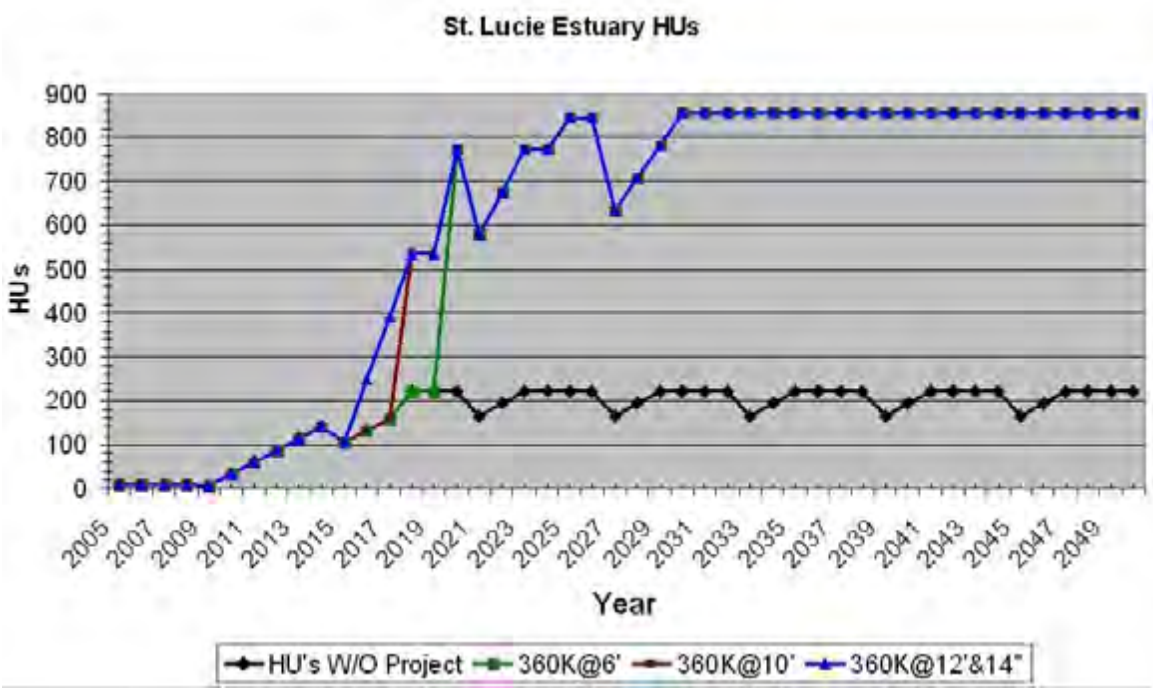

FIGURE 5-8: ECOLOGICAL BENEFITS FOR ST. LUCIE ESTUARY.

5.4.2.2.3 Caloosahatchee Estuary

This analysis showed that during high flow rates, when the reservoirs are used to provide storage of Lake Okeechobee water, the Project provides benefits to the Caloosahatchee Estuary. The quality index scores for the future without project and 360,000 acre-foot volume reservoirs are 0.32 and 0.81, respectively. This is expected from properly performing reservoirs in this location. The purpose of the EAA reservoirs is to store water from Lake Okeechobee during high water events to reduce regulatory releases to the estuaries and then to provide this water, which would have otherwise been lost to tide, to the EPA to the south during dryer periods. This Project alone would not be expected to provide additional water to the estuaries during low flow periods, and will depend upon the other elements of the CERP to provide those low flows that are necessary for the full restoration of the estuary. Figure 5-9 shows the annualized benefits to this estuary. These benefits have a similar pattern to that of the St. Lucie Estuary, whereby periodic regulatory releases are expected to continue until all CERP water storage projects come on-line. The main difference between this estuary from the St. Lucie Estuary is that the Project alone is not expected to benefit the Caloosahatchee Estuary. While the EAA reservoirs would capture regulatory releases from the lake, the model output shows that this alone will not restore the estuary, due to the high inflow of water from the Caloosahatchee basin runoff. The manner in which the Project helps the estuary is to capture Lake Okeechobee release water, and allow the other CERP projects, such as the

C-43 Reservoir, to capture basin runoff without the added burden of Lake Okeechobee water.

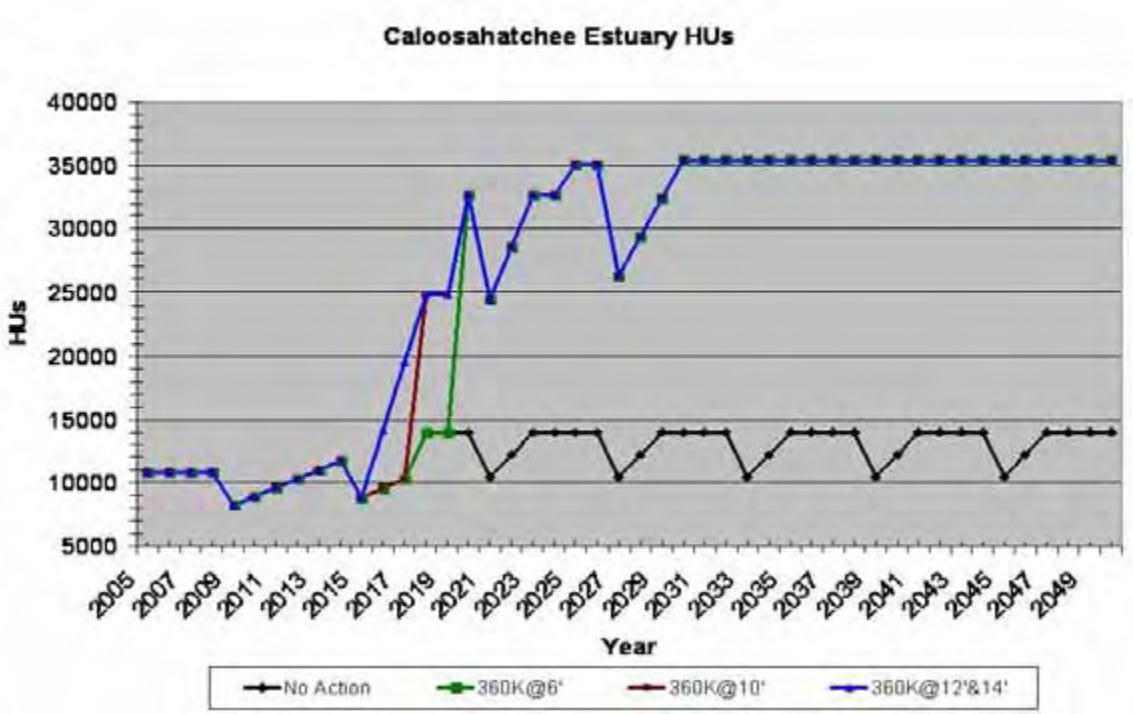

FIGURE 5-9: ECOLOGICAL BENEFITS FOR CALOOSAHATCHEE ESTUARY.

5.4.2.2.4 Greater Everglades

The model output shows an overall slight benefit to the ridge and slough habitat within WCAs 2 and 3 between the future without project and the 360,000 acre-foot reservoir, with quality index scores of 0.75 and 0.88, respectively. A larger benefit is seen for the tree islands, with scores of 0.67 and 0.86 between future without project and the project, respectively. While the improvement to the habitat may be slight, the effects are far-reaching, covering at least 257,586 acres of ridge and slough habitat, with 11,788 acres of that consisting of the tree islands. Annualized benefits are shown for these habitats in Figures 5-10 and 5-11. As in the other geographic regions, Alternatives 2 and 3 have delayed benefits due to the time required for buying additional land. This particular model output shows the future-without-project benefits increasing in the future. This relationship is thought to be the influence of rain-driven operations, which is actually part of full CERP implementation. A revised model run will be conducted with the corrected future assumptions, and revised ecological benefit calculations will be completed for the final PIR. Ridge and slough and tree island outputs were not calculated for Everglades National Park, even though it is expected that project implementation will increase the quantity and improve the timing of water delivered to the Park consistent with restoration objectives

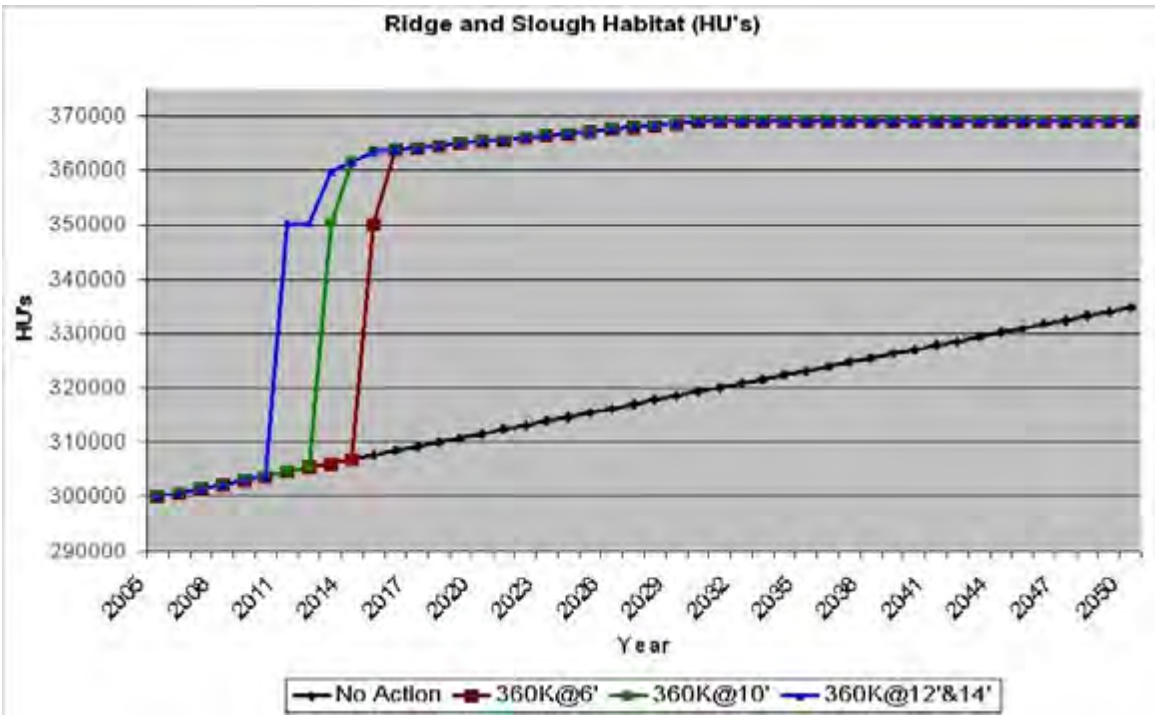

FIGURE 5-10: ECOLOGICAL BENEFITS FOR RIDGE AND SLOUGH HABITATS.

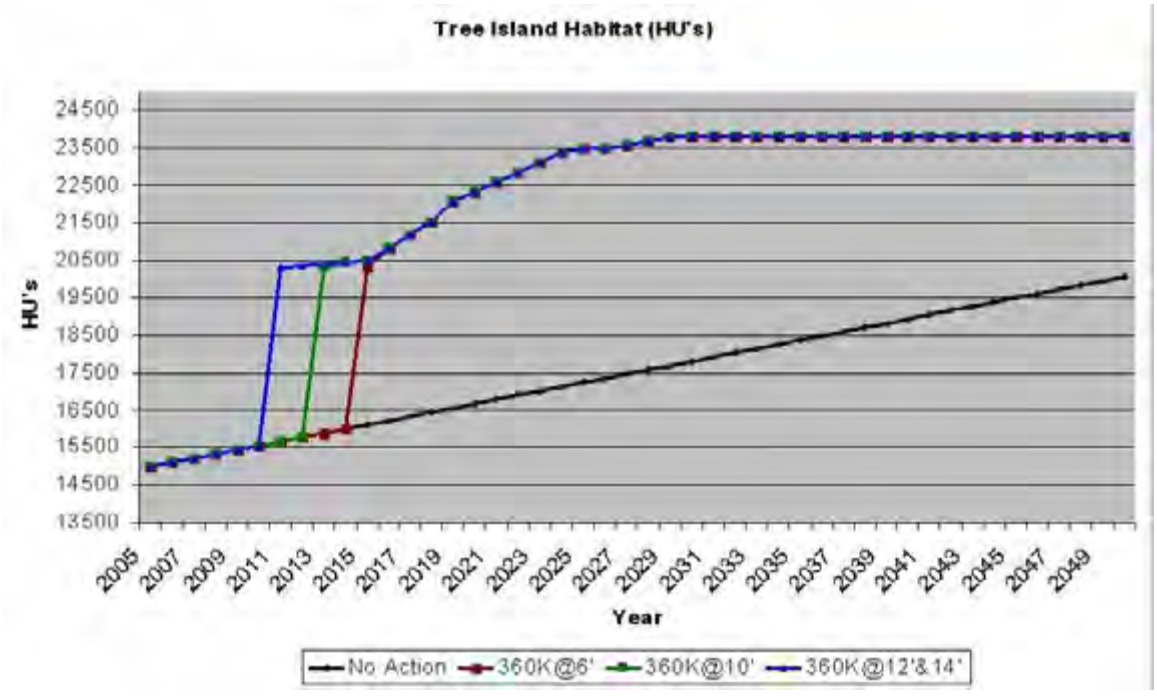

FIGURE 5-11: ECOLOGICAL BENEFITS FOR TREE ISLAND HABITAT.

5.4.2.3 Quantification of System-Wide Benefits

The combined average annual habitat units (CAAHUs) from each ecological region, described above, were combined using the following equation:

CAAHUs = HULO + HUSLE + HUCE + HURS + HUTI/5.776

where : HULO is the Habitat Units for the Lake Okeechobee region
HUSLE is the Habitat Units for the St. Lucie Estuary region
HUCE is the Habitat Units for the Caloosahatchee Estuary region
HURS is the Habitat Units for the Ridge and Slough habitat
HURI is the Habitat Units for the Tree Island habitat

The 5.776 denominator for the tree island variable is to account for overlap in the geographic regions of the ridge and slough and tree island variables. Although weighing could have been performed, this would not have affected the final ranking. Table 5-16 indicates the results that the varied construction periods have on average annual outputs yielded by the four alternatives, due to land acquisition requirements.

TABLE 5-16: EFFECT OF ALTERNATIVE IMPLEMENTATION UPON BENEFITS.

Ecological Region	Alternative 2	Alternative 3	Alternatives 4, 5 and 6
Lake Okeechobee	26363	27866	29358
Saint Lucie Estuary	164	175	180
Caloosahatchee Estuary	17422	18567	19667
Ridge and Slough	46385	48257	50040
Tree Island	2627	2819	3012
Combined Adjusted AAHUs	90798	95362	99776

5.4.3 Ecological Benefit Quantification of Local Environmental Design Features

The Ecological Sub-team quantified environmental design features that would result in additional project costs. The team based their scoring methodology on the WRAP, which is the wetland functional assessment methodology used by the USACE Jacksonville District Regulatory Division and the SFWMD Regulatory section. The team evaluated the entire seepage buffer as a wetland/tree island mosaic habitat. Each WRAP variable is scored on a 0-3 range. These variable scores are then summed and divided by the total possible score of 18 (6 variables x 3) to obtain the final WRAP score. The landscaped buffer was weighted by 1.5 to account for the synergistic habitat use between the wildlife habitat created by landscaping and planting and the aquatic habitat of the reservoirs that would be

used by particular species, such as osprey. Table 5-17 shows the scores for the WRAP variables and final score out of a 0 to 1 score range for the seepage buffer habitat. For the littoral shelf, the team used only those WRAP variables that were applicable to the habitat. The scores for Littoral Shelf Habitat are shown in Table 5-18.

TABLE 5-17: WRAP SCORES FOR SEEPAGE BUFFER HABITAT.

WRAP Variable	Existing Condition WRAP Score	Without Landscaping WRAP Score	With Landscaping WRAP Score
Wildlife Utilization	1	0.75	2
Wetland Overstory/Shrub Canopy of Desirable Species	.1	0	2
Wetland Vegetative Ground Cover of Desirable Species	1	0.5	1.75
Adjacent Upland/Wetland Buffer	.5	0.5	2
Wetland Hydrology	1	1	2
Water Quality Input and Treatment	1	2.25	2.25
Final Score	0.26	0.28	1 (0.67 * 1.5)

TABLE 5-18: WRAP SCORES FOR LITTORAL SHELF HABITAT.

WRAP Variable	Without Littoral Shelf WRAP Score	With Littoral Shelf WRAP Score
Wildlife Utilization	1.5	1.75
Wetland Vegetative Ground Cover of Desirable Species	0	1.75
Wetland Hydrology	0	1.75
Final Score	0.17	0.58

To convert these scores to Habitat Units, they were multiplied by the acreage of the buffer area. Table 5-19 shows the habitat units lift incurred with additional project costs.

TABLE 5-19: HABITAT UNITS FOR ENVIRONMENTALLY RESPONSIBLE DESIGN FEATURES.

Environmental Feature	Habitat Units Without Feature	Habitat Units With Feature	Total HU Lift	Total Cost	Total Cost/HUs
200’ seepage buffer (560 ac)	157	560	403	$500,000	$1241/HU
Littoral Shelf (76 ac)	13	44	31	$40,250	$1298/HU

The team feels the Habitat Units, which encompass the habitat provided for a diversity of wetland species, gained by these environmental features outweigh the additional cost for creating those features.

5.4.4 Risk and Uncertainty

Risk and uncertainty associated with the project were considered, including the adaptive assessment strategy.

5.4.4.1 Hydrologic Modeling

To formulate, evaluate, assess, and adaptively manage the CERP and this project, regional hydrologic simulation models, the SFWMM and the Natural Systems Model (NSM) were used. Both models use two-mile square grids with resolution based on available spatially distributed data. These models have been peer reviewed and represent the best available science and are considered reliable for current decision-making processes (and have been repeatedly used to support decision-making). However, there are inherent uncertainties in the prediction of ecological benefits or impacts as well as the functions associated with the reservoirs themselves.

These models depict general hydrologic conditions that are assumed to be representative throughout the individual 4-square-mile area (or in the case of Lake Okeechobee, the entire lake) grid cells that comprise the model. Therefore, they may not be fine enough in their resolution to simulate minor hydrologic changes that would result from variations in topography, soils, and vegetation within the grid cells, but which may be significant in terms of ecological response. Even if the hydrologic model shows differences in alternative plans in relationship to hydrologic targets, it is often difficult to discern the ecological magnitude of the relative differences between alternatives. Also, the relative size difference between the reservoirs and the affected areas (Lake Okeechobee, the St. Lucie and Caloosahatchee Estuaries, and WCA-3) is such that even large changes in volume of water stored within the reservoirs cannot be easily seen when water is spread over such a large area. Thus, with the combined effect of the model grid size and scale of reservoirs compared with the ecosystem, the model cannot readily discern the differences among alternatives.

The uncertainties in using these models to predict reservoir function relate to the use of historical data, including:

1. Failure to be filled by the time of commissioning.
2. Mean flow below what has been expected.
3. Clustering of wet and dry years, especially occurrence of a prolonged dry period.
4. Faster reservoir sedimentation than expected.

The risks due to this project are:

1. Risk to downstream settlement due to dam breach.
2. Higher than expected downstream damages during release of major floods due to infrastructure encroachment of flood plains.

To minimize these risks, a sub-regional model was used to determine seepage rates and probability of spillover and the reservoirs operations manual will include management measures such as:

1. Developing a reservoir regulation schedule.
2. Creating flood storage prior to predicted storm.
3. Design of outlet structures to handle release water after a major storm in preparation for a subsequent storm.

5.4.4.2 Engineering

The risk and uncertainty associated with the construction and operation of the features of the EAA Storage Reservoirs project and earthen embankment construction should be minimal. All features have been designed and constructed through established and applied technology. Additionally, both the USACE and the SFWMD have extensive and reputable credibility in the design, construction, and operation and maintenance of the proposed features from previous water resources planning efforts.

However, there are uncertainties associated with the construction of an RCC embankment. These include, 1) the fact that the USACE and SFWMD both have more experience constructing earthen levees in South Florida than RCC structures of this scale; 2) the current shortage of Portland cement in South Florida which could significantly increase RCC cost estimates (the USACE's Cost Engineering Branch is currently investigating this cost issues to determine if changes to future cost estimates are appropriate); and, 3) the fact that limited geotechnical data is available for the entire area being considered for the reservoirs, which could affect the cost estimates for foundation treatment and cut-off wall required for RCC construction (both the USACE and SFWMD are currently collecting additional geotechnical data within the Study Area that will be available for use in the final PIR).

5.4.4.3 Evaluation of System-wide Ecological Effects of Hydrologic Performance Measures

Hydrologic performance measures are useful for determining and comparing the effects of alternative plans. However, to determine a plan's outputs for purposes of depicting NER benefits, the assumption is made that the hydrologic

performance measures fully characterize all of the attributes of ecosystem functions, since the analytical tool for system-wide effects is a hydrologic simulation model. This assumption results in some uncertainty with respect to the evaluation of system-wide ecological responses because not all ecological attributes can be simply reduced to hydrologic terms. However, to reduce some levels of uncertainty, the hydrologic performance measures have been related to certain ecological attributes by the Ecological Sub-team.

Another uncertainty exists in the correlation between small hydrologic changes seen in the outputs of a regional model, and the ecological significance of those changes. The hydrologic change in a model grid cell, indicator region, or geographic sub-region that may result from individual projects is typically small in relative magnitude. Although target conditions are established for these hydrologic performance measures, the scientists on the ecological subteam have determined that the relatively small differences between alternatives (difference of less than 10%) for some of the performance measures does not lend itself to meaningful ecological differences. Therefore, there is some uncertainty in predicting the extent of system-wide change in ecological attributes due to relatively small differences in the hydrologic changes associated with incremental implementation of individual CERP projects.

To reduce the uncertainty in evaluating relative differences among the alternatives, the ecological subteam accepted only those scores of differences of at least 10 percent. In light of these uncertainties, the predicted ecological benefits should be considered in terms of trends and relative differences among the alternatives.

5.4.4.4 Variability of Ecological Response Time

Determining the individual variable spatial response to hydrologic change of each attribute within an ecosystem is uncertain at best. Each of the conceptual ecological models (CEMs) that are the basis for the system-wide hydrologic performance measures encompass multiple ecological attributes (for example, oyster beds, submerged aquatic vegetation, and fish populations are all attributes of the St. Lucie Estuary CEM). Each attribute may vary independently in the response time to changes in hydrology. Changes in freshwater wetland vegetation will be gradual and increase over time as hydropatterns and hydroperiods within the natural system are altered; changes in estuarine vegetation typically occur on a shorter time scale. Depending on the life cycles, different resources in the natural system will differ in ecological response time.

Also, different aspects of wildlife responses to hydrologic change occur over different time scales. For example, snail kite nesting and foraging is dependent

on water stages at certain times of the year, and beneficial responses are anticipated to begin immediately with the operations of the reservoirs. Actual restoration of colonization numbers in Lake Okeechobee and WCA-3 may take several nesting seasons.

5.4.4.5 Sequencing and Adaptive Assessment

The CERP consists of 68 major components and six pilot projects. Significant uncertainty associated with the individual compartments and the Comprehensive Plan was recognized during the Restudy. There are a large number of potential combinations of these compartments that may result from differences in design and operational schedules developed through the PIR process. Even as planning efforts for the separate projects evolve, there are also changes in budgets, policies, resource demands, and operation principles. As such, a fundamental implementation principle for the CERP is to utilize adaptive assessment and management in order to continually refine and improve the performance of the CERP. Incremental revisions throughout the planning and implementation process of the CERP will lead to optimal designs and operations of projects to improve performance. The order and schedule for project implementation will also be optimized to achieve the desired ecological responses. The use of the adaptive assessment policy minimizes the effects of uncertainty with respect to the effects of CERP projects on the natural system and other water-related needs of the region related to the design and implementation of the CERP.

5.4.4.6 Construction Cost Estimates

No statistical analysis of cost risk was performed. Normal design variances are expected and normal contingency values are used. The risk of cost overruns is considered to be low.

5.4.4.7 Project Schedule

It is not anticipated that any new tasks will be required that would increase overall project delivery dates. As such, no negative impacts to project schedules are anticipated.

5.4.4.8 Land Available and Acquisition Issues

There is some uncertainty associated with the land availability, cost, and time to acquire the additional lands necessary for the construction, operation, and maintenance of Alternatives 2 and 3.

5.4.5 Evaluation of Alternative Plans

Each alternative plan has been evaluated by analyzing the effects of the plans against various sets of evaluation categories and criteria. The results of the evaluations listed in Table 5-20 were arrayed and compared to identify significant differences among the plans.

TABLE 5-20: EVALUATION MATRIX

Category of Effect	Units	Alternative											
		1 (w/o proj)		2		3		4		5		6	
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank
NED Account													
Cost (Avg Annual)	Avg Ann $ ($1,000)	0	6	$65.0	2	$55.6	5	$64.9	4	$65.0	3	$67.1	1
Total Project Cost	Initial Cost $ ($1,000)	0	6	$1,100	1	$860	5	$912	4	$916	3	$948	2
Recreation benefits	Rank		1		2.5		5		5		2.5		5
NER Account													
Environmental Output	Avg Ann HUs	0	1	87,280	2	91,814	3	96,244	5	96,244	5	96,244	5
Water Deliveries to ENP	Avg Ann Ac-Ft	0	1	900,000	2	918,000	4	920,000	5.5	920,000	5.5	912,000	3
EQ Account													
Fish and Wildlife Impacts:													
1. In Reservoir	Rank		1		2		3		5		5		5
2. On Embankments	Rank		2		4.5		4.5		4.5		1		4.5
3. Seepage Buffer Areas	Rank		1		6		5		3		3		3
T&E Species	Rank		1		3		5		5		2		5
Aesthetics	Rank		1		4		5.5		5.5		1		4
Cultural Resources	Rank		6		1		2		3.5		3.5		5
Air Quality	Rank		6		1		2		5		5		2
Water Quality (nutrients)	Rank		1		2		3		4.5		4.5		6
RED Account													
Employment (during const.)	Rank		1		3		2		4		5		6
Employment (post-const.)	Rank		1		6		3		5		2		4
Agricultural Production	Rank		6		1		2		3.5		3.5		5
Local Farm Tax Revenues	Rank		6		1		2		3.5		3.5		5
Note: Ranks are 1 for lowest performance/ delivery thru 6 for highest performance/ delivery													

Category of Effect	Units	Alternative											
		1 (w/o proj)		2		3		4		5		6	
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank
OSE Account													
Public Health and Safety	Rank		6		3.5		3.5		3.5		1		3.5
Subsidence	Rank		1		2		3		4.5		4.5		6
Real Estate Considerations													
Total Acres (for info only)				60,000		37,920		31,494		31,494		26,176	
Loss of Farms	# farms		6	70	1	15	2	3	4.5	3	4.5	3	3
RE Cost Variability	Rank		6		1		2		4.5		4.5		3
RE Funding Stream	Rank		6		1		2		4.5		4.5		3
RE Availability	Rank		6		1		2		4.5		4.5		3
Construction Risk & Uncertainty													
Experienced Contractor Avail	Rank		6		3.5		3.5		3.5		1		3.5
Level of Difficulty	Rank		6		3.5		3.5		3.5		1		3.5
Cement Price & Availability	Rank		6		3.5		3.5		3.5		1		3.5
Fuel Costs	Rank		6		3		3		3		3		3
Site & Geology Risk	Rank		6		3.5		3.5		3.5		1		3.5
Seepage Control	Rank		6		3.5		3.5		3.5		1		3.5
Cost Variability	Rank		6		3.5		3.5		3.5		1		3.5
O&M Mowing/ Erosion Cont.	Rank		6		2.5		2.5		2.5		5		2.5
Funding Stream	Rank		6		3		3		3		3		3
Other Principles & Guidelines Criteria													
Efficiency	Rank		1		2		4.5		4.5		6		3
Acceptability	Rank		1		2		4		5.5		3		5.5
Effectiveness	Rank		1		2		3		5		5		5
Note: Ranks are 1 for lowest performance/ delivery thru 6 for highest performance/ delivery													

5.4.5.1 Evaluation Accounts

Effects of the alternatives in the four evaluation accounts listed in the P&G which include – National Economic Development (NED)/ National Ecosystem Restoration (NER), Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE).

5.4.5.2 NED Account

The NED Account is represented by Average Annual Cost, Total Project Cost and Recreation Benefits. The Average Annual Cost and Total Cost were based on the actual dollar amounts and were ranked accordingly. The Recreation Benefits ranks were based on consensus between project team planners and economists, with rankings derived from estimated recreation benefits.

The "without project" ranked best for the Average Annual Cost because it has no cost, while the Alternative 6 ranks the worst as it has the highest project cost among the alternatives. Similarly, the Total Project Cost followed the same ranking logic as the Average Annual Cost component, with "without project" condition achieving the highest rank due to no cost and Alternative 6 ranked lowest, due to higher costs than the other alternatives.

Alternatives 3, 4 and 6 achieved the highest ranking for the Recreation because they maximized recreation potential compared to the other alternatives, while the "without plan" condition achieved the lowest score due to the lack of recreational opportunities. Additional information can be found in Appendix C, Socio-Economics.

5.4.5.3 NER Account

The National Ecosystem Restoration account is represented by Environmental Output and Water deliveries to Everglades National Park. The NER account is ranked by the number of average annual habitat units produced by construction of an alternative and average annual acre feet of water delivered to ENP as a result of the alternative plans. The rankings given to items in the NER account were determined by members of the project's ecological subteam.

Alternatives 4, 5, and 6, having identical production of average annual habitat units, all achieved the highest ranking for environmental output, while the "without project" condition achieved the lowest ranking.

Alternatives 4 and 5 ranked highest in water deliveries to ENP (identical rankings due to identical delivery capacity), while Alternative 1 (without plan) ranked lowest. Additional information can be found in Appendix E, Environmental Appendix.

5.4.5.4 EQ Account

For the EQ account, alternatives were ranked for Fish & Wildlife Impacts, Threatened & Endangered Species, Aesthetics, Cultural Resources, Air Quality and Water Quality. For the Fish & Wildlife Impacts, alternatives are ranked for: in reservoir impacts; embankment impacts; seepage buffer area impacts and existing wetland impacts. The ranks were determined by the ecological subteam (USACE, USFWS, EPA, FWC and SFWMD) in consideration of how each alternative is affected.

Alternatives 4, 5, and 6 have similar in reservoir impacts, because, generally, a deeper reservoir is better for fish habitat, while the "without project" condition alternative ranked the lowest. Embankment Impacts are relatively the same for each of the alternatives that include earthen embankments while the Alternative 1 and 5 provide no embankment habitat. Alternative 2 ranked best for Seepage Buffer Impacts because the larger footprint provides more seepage buffer. Conversely, the Alternative 1 (without project) condition provides no seepage buffer habitat and ranked lowest among the alternatives.

For Threatened & Endangered Species, Alternatives 3, 4, and 6 produce similar benefits while Alternative 5 (concrete embankment) would not offer viable habitat for the list species considered.

For aesthetics, the concrete is not a "natural" feature relative to earthen embankments. Trees, however, are expected to grow in the seepage buffer but it may take 10 years before the trees grow large enough to hide the embankment. The higher the levee or larger the footprint, the lower the score, as man-made features are not aesthetically pleasing for an environmental restoration project. Alternatives 3 and 4 rank the best while Alternatives 1 and 5 ranked worst.

Smaller footprint reservoir alternatives and Alternative 1 (without project) are desirable for not disturbing cultural resources. The Alternative 1 condition is the best because no lands are disturbed, while the Alternative 2 is the worst because of the large footprint.

The main criteria for Air Quality ranking is the pumping capacity required for each alternative depth. The larger pumps will produce more "pollution", leading to lower air quality. Alternative 2 requires a total of 8,000cfs of pumping, Alternative 3 requires 7,500cfs of pumping, Alternatives 4 and 5 require 6,900cfs of pumping and Alternative 6 requires 7,600cfs of pumping. Therefore, Alternative 1 ranked the highest, while the Alternative 2 ranks the lowest.

Water Quality is generally determined by depth. Deeper reservoirs provide less chance for of reservoir dry-down and possible remobilization of nutrients and other constituents that have settled into reservoir sediments. Therefore Alternative 6, because it is deepest, ranks the highest while the "without project" condition ranks the lowest. Additional information can be found in Appendix E, Environmental Appendix.

5.4.5.5 Regional Economic Development Account

The Regional Economic Development (RED) account is represented by Employment created during construction, Employment created after construction, Agricultural Production and Local Farm Tax Revenues. The benefits were generated using RIMS II multiplier programs and local tax rolls.

Employment during construction is based on RIMS II output, which is derived using construction costs. Alternative 6 has the highest construction cost, thus the greatest regional multiplier effect, while Alternative 1 creates no regional employment benefits.

Employment after construction is based on O&M costs. Greater O&M efforts generally require more manpower. Alternative 2 is more costly due to the larger footprint while Alternative 1 condition carries no O&M cost.

The larger footprint alternatives will take more agricultural land out of production, while Alternative 1 leaves all lands in production. The lands that are in production will continue to generate tax revenue. Alternative 1 will remain the best for both agriculture related components in the RED account. Additional information can be found in Appendix C, Economic and Social Considerations.

5.4.5.6 OSE Account

The Other Social Effects (OSE) account considers the effects of alternative plans in areas that are not already contained in the NED and RED accounts. The categories of effects contained within the OSE account include:

- Urban and community impacts,
- Life, health, and safety factors,
- Displacement,
- Long-term productivity, and
- Energy requirements and energy conservation.

The EAA alternative restoration plans could result in beneficial and adverse OSE within the study area. The alternative restoration plans could have positive or adverse OSE impacts on the study area associated with (1) plan

implementation, including land acquisition, project construction, and operations and maintenance (O&M) activities, and (2) operation of the modified C&SF system. As in the case of the NED effects, the OSE account is concerned with the net effects of the alternative plans (i.e., the differences between the with- and without-project future conditions).

5.4.5.7 Real Estate Considerations

Evaluation of Real Estate considerations is based on the number of parcels to be acquired for different reservoir footprints, escalating land values, and sponsor ability to acquire parcels. The ranking of the alternatives are uniform across each of the real estate factors.

5.4.5.8 Construction Risk & Uncertainty

Risk and uncertainty effects associated with planning, design and constructing the EAA reservoirs are identified in each alternative with sensitivity to methods and materials to be used for the identified alternative. A listing of the specific risk and uncertainties have been developed for identification and ranking where numerical measures are available to support their evaluation. For simplification, these effects are identified as Construction Risk and Uncertainty. The following information details are provided in support of the numerical ranking provided in the table.

Experience and contractor availability is rated higher for Earthen Embankment construction due to the larger number of experienced heavy construction contractors in the region. RCC is rated slightly lower even though credible and capable contractors would be expected to respond. Several regional and also national contractors may be attracted for the scope of work defined for all plans.

Level of difficulty - contractors will incur higher risk and uncertainty in pricing and performance for RCC compared to Earthen Embankment. RCC is still considered a developing technology and is much more sensitive for QA/QC, particularly with regard to mix control (processing aggregate and fines) and moisture control. Placement techniques are to be developed in greater detail; i.e., use of forms and slope placement for three ~8.66-foot steps. RCC has been developing with broader usage over the past decade and a half. Originally developed for severe and intensive applications such as intermodal shipping and forestry operations and military tank trails and staging areas; it is widely used in dam structures as it will be with EAA. Earthen Embankment is given an edge due to simplicity, but it remains material quantity sensitive with higher costs than RCC.

Volatility of availability and cost for cement is identified as a significant risk for RCC. Cement is only available from large regional suppliers such as Titan

Florida Cement and CSR Rinker. Recent concerns with cement availability have proven Florida is in a unique market with demand exceeding all historic records. Florida was named a leading national "hot market" with the other two prevalent developing geographic areas, Texas and California. In 2001, estimating future projects, recently or currently bidding, developed concrete unit pricing of $65/CY. For these same projects, estimating now has concrete at $95/CY (a 46% increase). Regional cement production increases are under development, but much will go to current distribution networks and record level imported cement is also linked to Florida cement operators. Expansion efforts by the cement industry typically take up to four years with permitting and construction.

Fuel pricing variability will apply nearly equal to both Earthen Embankment and RCC alternatives. Alternative pool depths also affect quantities of materials to be placed and operations costs of fuel-powered equipment. December 2004 pricing for on-road and off-road diesel was $1.19 and $0.93. Mid-2005 estimated pricing is $2.01 and $1.80 (+67% and +94%). While the RCC footprint is smaller, it involves hauling from a central batch plant and is equipment sensitive for placing.

Site and geology risks include additional foundation preparation required for RCC where cap rock thins out, and available quantities of near by borrow source materials for both systems. Current assumptions for foundation prep and correction of defects are estimated at approximately 20% for RCC embankment. RCC requires general removal of peat and undesirable surface material cleanup, dental concrete work; thin caprock and existing cavities sections require full or partial depth RCC placement. Formation of cracks will contribute to through seepage (no waterstops). An Earthen Embankment requires general removal of peat and undesirable surface material cleanup, and some dental concrete work.

The basic difference in site and geology relates to quantities of materials to be placed. The RCC section has an advantage with the smaller footprint and less total quantities of materials placed. The seepage canals provide most of the needed materials – blasted rock, silty-sands, and remaining is quarried near the centrally located batch plants. The Earthen Embankment also uses the seepage canals and central borrow areas for available embankment fill materials. The interior for both systems includes earth embankments that are soil-cement and riprap covered, and these embankments are placed to reduce wave run up. Silty-sands excavated in the wet require drying by turning and disking prior to use. RCC is given an advantage for erosion control as the Earthen Embankment requires riprap to the top of inside face and stone for crest as a wearing surface.

Seepage control is provided by bentonite filled slurry walls. The depths of the slurry wall for the Earthen Embankment vary from 35- to 50-Foot. The depth of the slurry wall is 50-Feet for RCC due to having a smaller section increasing.

Seepage control is not required along the common Phase 1, Cell1 and STA embankment section. Some measure of seepage control will be developed for Holey Land for both systems. The Earthen Embankment cutoff has an advantage with less quantities and depths.

Cost Variability issues include risk and uncertainty as are addressed within this paper, but also consider a deviation in estimated probable cost by the COE and SFWMD methods and quantities for both Earthen Embankment and RCC.

O&M Delta considers only additional slope areas to be maintained with Earthen Embankment for erosion repair and mowing. Applying $1,500/Acre/Year, the 6-, 10-, 12- and 14-Foot has $8.9, $7.9, $7.7, and $7.8 million, respectively (present worth).

Assuming a continued funding stream, both methods are considered nearly equal. However, should the contract be terminated for convenience, the RCC plant demobilization is considered an additional cost/risk. The additional schedule for the acquisition of real estate for Alternative 2 is considered elsewhere in the table.

Other construction process effects are measured under broader and related categories. These other categories include: Environmental Quality – Air Quality; Social Economic - 8A involvement; Regional Economic Development - Employment (during construction) and Tax Revenues.

First, in terms of air quality, both systems have airborne particulates; however, measures will be taken to minimize dust from excavation and embankment fill and compaction operations by maintaining moisture levels in soils and along haul routes. Also management from airborne particulates from batch plant operations will be required. A slight advantage is given to the earth placement process. Aesthetics is addressed under Environmental Quality and is not addressed from Construction perspective.

Addressing Social Economic and Regional Economic Development, the 8A contract provision will be met by both systems, and employment during construction and tax revenues is also addressed within their respective category. Additional information can be found in the Engineering Appendix (Appendix A).

5.4.5.9 Other Principals and Guidelines Criteria

Other Principal and Guidelines Criteria identified by Corps planning guidance include Efficiency, Acceptability, Effectiveness and Completeness. Efficiency is based on the cost per habitat unit of each alternative. Acceptability is the likelihood that there will be acceptance of the project among all stakeholder

groups ("1" means no acceptance, "6" means greatest acceptance among stakeholders). Effectiveness is based on achievement of planning objectives and generation of habitat units ("1" represented the alternative with the least number of planning objectives while a "6 "represented the alternative the achieved the greatest number of planning objectives). Completeness is uniform for each of the project alternatives, and therefore is not included in the evaluation matrix.

5.4.6 Plan Comparison using Cost-Effectiveness and Incremental Cost Analyses (CE/ICA)

Cost-effectiveness analysis begins with a comparison of the costs and outputs of alternative plans to identify the least cost plan for every level of output considered. Alternative plans are compared to identify those that would produce greater levels of output at the same cost, or at a lesser cost. Alternative plans identified through this comparison are the cost-effective alternative plans. Next, through an incremental cost analysis, the cost-effective alternative plans are compared to identify the most economically efficient alternative plans, that is, the "Best Buy" alternative plans that produce the "biggest bang for the buck." Cost-effective plans are compared by examining the additional (incremental) costs for the additional (incremental) amounts of output produced by successively larger cost effective plans. The plans with the lowest incremental costs per unit of output for successively larger levels of output are the "Best Buy" plans. The results of these calculations and comparisons of costs and outputs between alternative plans provide a basis for addressing the decision question "Is it worth it?"

System formulation outputs used for CE/ICA are displayed in Table 5-21. The basis for average annual output calculations was previously explained. Note that the output values reflect the differences between without project and with project on an average annual basis (i.e., ecological "lift" provided by each of the alternatives).

TABLE 5-21: ECOLOGICAL OUTPUTS (AVERAGE ANNUAL HABITAT UNITS) USED FOR CE/ICA.

Average Annual Habitat Units	Alternative 2	Alternative 3	Alternatives 4, 5 and 6
Lake Okeechobee	26363	27866	29358
Saint Lucie Estuary	164	175	180
Caloosahatchee	17422	18567	19667
Ridge and Slough	46385	48257	50040
Tree Island	2627	2819	3012
Adjusted Total*	90798	95362	99776

* Note: Totals are not additive due to the fact that tree island habitat units are adjusted (divided by a factor of 5.776) to account for geographic overlap with ridge and slough habitat.

Table 5-22 and Figures 5-12 and 5-13 represent the results of the cost-effectiveness analysis for the five alternatives. Figure 5-13 shows costs and outputs for all alternative plans. Table 5-22 shows that both the 10-foot alternative (Alternative 3) and the 12-foot (Alternative 4) earthen alternative are cost-effective. The 10-foot alternative costs $53.8 million on an average annual basis, provides 95,362 average annual habitat units, and costs $565 on an average annual basis per average annual habitat unit. The 12-foot earthen alternative costs $ 62.5 million on an average annual basis, provides 99,776 average annual habitat units, and costs $627 on an average annual basis per average annual habitat unit. Figure 5-13 shows these cost-effective plans.

TABLE 5-22: RESULTS OF COST-EFFECTIVENESS ANALYSIS.

	Average Annual Habitat Units	Average Annual Cost	Cost per Habitat Unit	Cost Effective?
Alternative 2	90,798	$63,198,831	$696	No
Alternative 3	95,362	$53,834,816	$565	Yes
Alternative 4	99,776	$62,545,505	$627	Yes
Alternative 5	99,776	$62,654,650	$628	No
Alternative 6	99,776	$64,705,127	$649	No

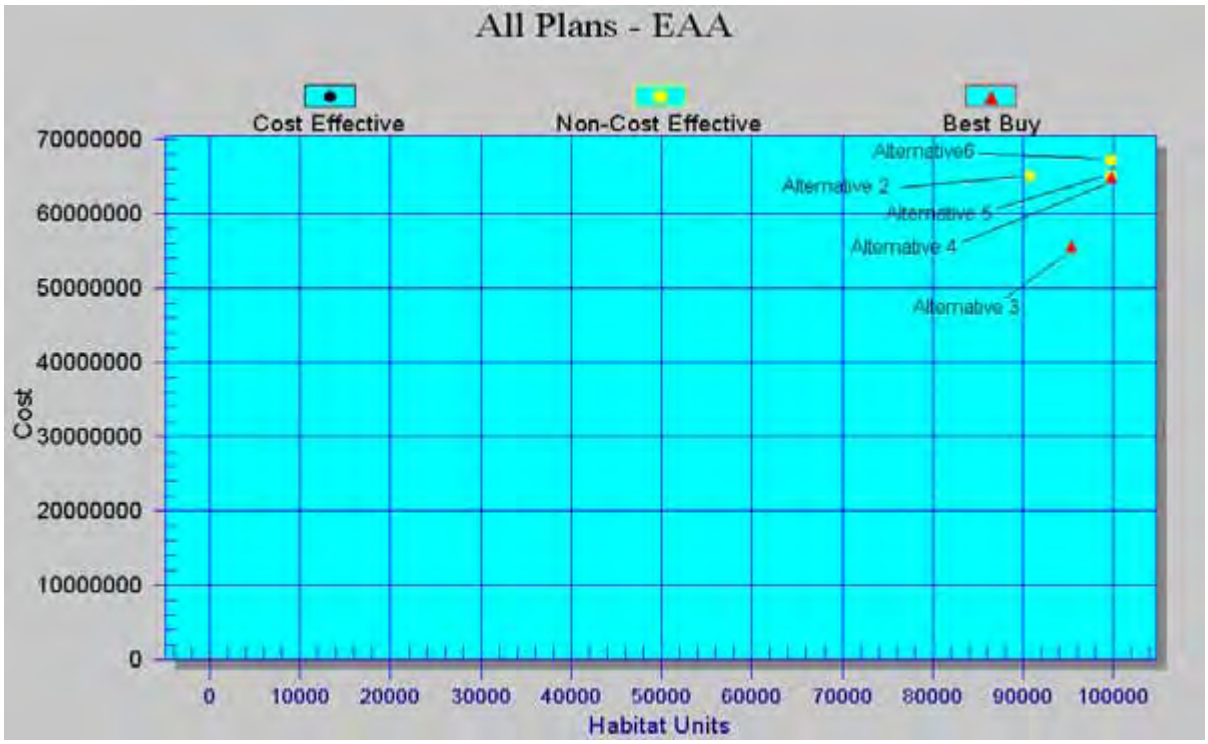

FIGURE 5-12: EAA ALTERNATIVE PLANS – CE/ICA RUN ON COMBINED AVERAGE ANNUAL HABITAT UNITS FOR ALL ALTERNATIVES.

FIGURE 5-13: EAA COST EFFECTIVE PLANS – CE/ICA RUN ON ALL ALTERNATIVES.

Next, an incremental cost analysis was performed on these cost-effective plans. Table 5-23 shows these results. The first Best Buy plan, the 10-foot alternative, exhibits an incremental cost of $565 per habitat unit, delivering a total of 95,362 average annual habitat units. The second Best Buy plan, the 12-foot earthen alternative, delivers an additional 4,414 average annual habitat units at an incremental cost of $1,973 per habitat unit. These results are displayed in Figure 5-14.

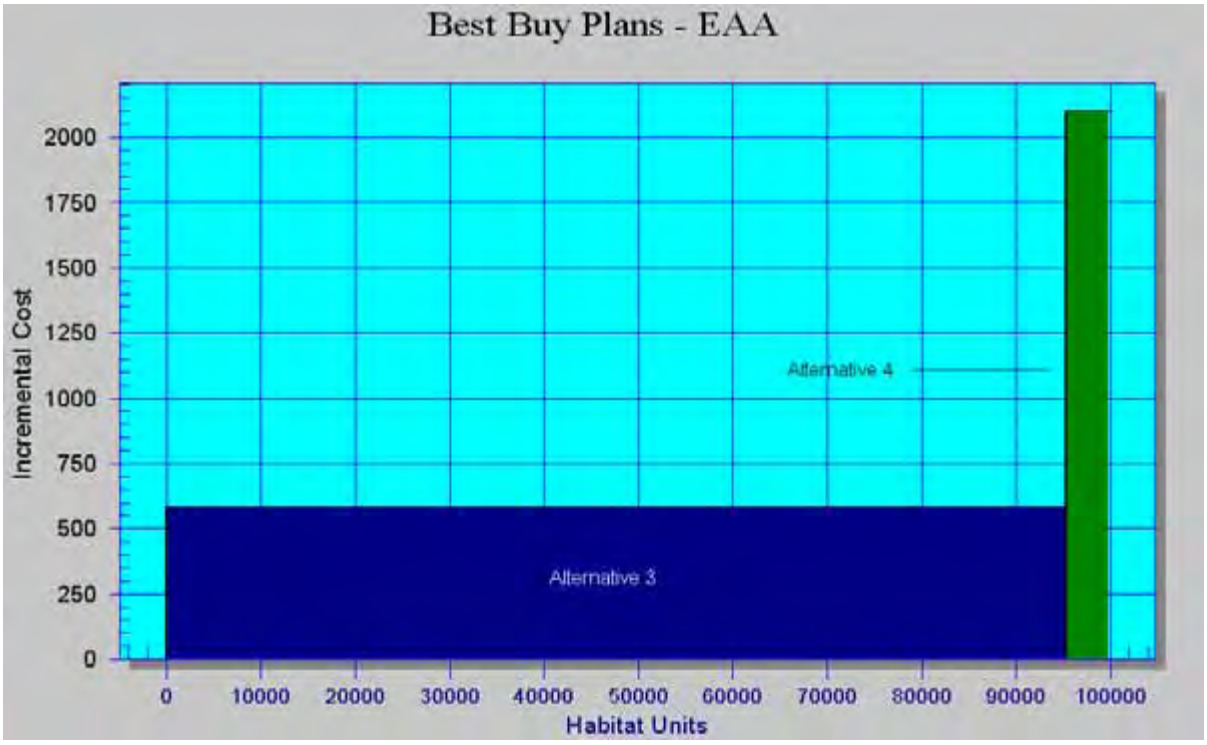

FIGURE 5-14: INCREMENTAL COST ANALYSIS. COST EFFECTIVE AND BEST BUY PLANS

TABLE 5-23: RESULTS OF INCREMENTAL COST ANALYSIS: COST EFFECTIVE AND BEST BUY PLANS ARRAYED BY INCREASING OUTPUT FOR COMBINED HABITAT (ALL PLANS).

	Average Annual Cost	Output	Average Cost Per Output	Incremental Average Annual Cost	Incremental Output	Incremental Cost Per Output	Best Buy?
ALT 1	$0	0	N/A	N/A	N/A	N/A	
ALT 3	$53,834,820	95,362	$565	$53,834,820	91,814	$565	Best Buy
ALT 4	$62,545,505	99,776	$627	$8,710,689	4,414	$1,973	Best Buy

5.5 IDENTIFICATION OF THE NATIONAL ECOSYSTEM RESTORATION (NER) PLAN

In identification of the National Ecosystem Restoration (NER) plan, USACE Engineering Regulation 1105-2-100, Appendix E, Section V requires that decision-makers take into account achievement of planning objectives, the results of CE/ICA, the significance of project outputs, the four Principles and Guidelines criteria of acceptability, completeness, effectiveness, and efficiency, and risk and uncertainty considerations. Based on the results of CE/ICA alone, and observing the breakpoint between the first and second Best Buy plans, a recommendation might be made to select the 10-foot earthen embankment because it has the lowest incremental costs per unit of output of any of the alternatives at $565 per average annual habitat unit. However, Alternative 4 is cost-effective in that it delivers the same or more output than Alternative 2 and Alternative 6 at lower cost. It is also a Best Buy plan, delivering more output (4,430 habitat units) than Alternative 3, albeit at a higher incremental cost per unit of output. Alternative 4 meets the strict CE/ICA criteria set by ER 1105-2-100.

In interpreting the results of the incremental cost analysis, it should also be noted that Alternative 4's total investment cost is $53 million greater than Alternative 3 ($1,006.3 million versus $953.3 million), a 5.6% increase. At the same time, outputs on an average annual basis increase by nearly 5% between Alternative 3 and Alternative 4, from 95,362 AAHU's to 99,776 AAHU's. The requirement to use average annual costs in CE/ICA unfavorably reflects the incremental cost per unit of output of the Alternative 4. Average annual cost calculations penalize the Alternative 4 due to present worth calculations.

Alternative 4 is more acceptable to stakeholders within the EAA, the local sponsor, and potentially to federal policy-makers, primarily because the reservoir footprint can be accommodated completely within lands already acquired by the Federal government and the local sponsor. There are several advantages of not having to acquire additional lands. First, local stakeholders within the EAA have voiced opposition to having additional lands taken out of agricultural production. Detrimental impacts to the local farming economy and to the viability of such EAA business concerns as sugar mills have been raised in objection to utilizing an additional approximately 6,500 acres required for Alternative 3. The local sponsor, state, and federal interests mounted a very significant land acquisition effort for this facility beginning in the mid 1990s culminating in the purchase of the Talisman Sugar Corporation land holdings. Subsequently, a number of land exchanges with other land owners in the vicinity were executed to consolidate the Talisman land into a contiguous, usable footprint. All the partners invested substantial time and effort in this successful undertaking. At this time, the local sponsor believes that the acquisition of

additional, contiguous land may require condemnation which would make the acquisition economically unfeasible and extend the implementation timeframe to an unacceptable degree. In the complicated land exchanges that took place in connection with the Talisman land purchase, some privately-held lands were given to the SFWMD to build reservoirs in exchange for lands assumed to be outside the reservoirs footprint, with the promise that the SFWMD would not return later to acquire those exchanged lands as well. The unacceptability of breaking this agreement to all parties is self-evident. From a Federal policy perspective, there is also a reluctance to acquire additional private real estate when the project objectives can be achieved on real estate already owned by the state. USACE policy seeks to minimize real estate costs as a percentage of total project costs.

In terms of additional criteria employed to identify the NER plan, both Alternatives 3 and 4 deliver significant (as defined through institutional, technical, and public recognition) outputs to the Greater Everglades ecosystem – increased habitat in the St. Lucie and Caloosahatchee Estuaries, Lake Okeechobee, and in the Ridge and Slough and Tree Island habitats of the Everglades itself. However, Alternative 4 reasonably maximizes those outputs, providing 4,406 more habitat units on an average annual basis. Considering completeness, both Alternatives 3 and 4 are equally complete plans – other features are not required for the EAA storage reservoirs to function as designed. Similarly, the efficiency of both plans is demonstrated through the results of CE/ICA, although Alternative 3 is slightly more efficient in terms of cost per unit of output on an average annual basis ($565) versus Alternative 4's $627. In the area of effectiveness, modeling results indicate that the greater water depth of Alternative 4 reduces evapotranspiration, which actually increases the available hydrologic flow to the ENP. Unfortunately, water volumes are not reflected in the ecological habitat unit calculations (the ENP is outside the spatial extent for which habitat units were calculated). Nonetheless, Alternative 4 appears to be more effective in terms of water conservation and water quantity.

Finally, in terms of the risk and uncertainty criterion, by definition there is greater risk and uncertainty in having to purchase additional lands for project construction (as with Alternatives 2 and 3), with potential delays in land acquisition and known delays in the project construction schedule, than there is with Alternative 4 where all the necessary real estate already in state ownership.

Thus, taking all the ER 1105-2-100 criterion into account, Alternative 4 was identified as the NER plan. It is the most acceptable and effective alternative, as well as being complete and efficient. It proves the greatest amount of significant outputs, and also poses less risk and uncertainty than Alternative 3.

5.6 PERFORMANCE OF THE NEXT ADDED INCREMENT (NAI)

The programmatic regulations require evaluation of the tentatively selected plan as the "next-added increment." The next-added increment analysis evaluates the effects, or outputs, of the tentatively selected plan as the next project to be added to the group of already approved CERP projects. This analysis helps illuminate the amount of benefits the selected alternative plan contributes without regard to future CERP projects. It also helps to ascertain whether sufficient benefits would accrue to the selected alternative plan to justify the cost, if no additional CERP projects (other than those already existing or authorized) were implemented.

The next added increment analysis used model runs provided by the Interagency Modeling Center designed specifically for evaluation of the NAI using the start-up operating plan. Details on the performance measures, evaluation methodology, and quality index scores used to determine the habitat units (HU) for each region is described in Appendix C. A discussion of the results follows.

5.6.1 Lake Okeechobee NAI Performance

The NAI model run (NAI-S5A) based on the start-up operating plan demonstrates the project would produce additional 14,601 AAHUs for Lake Okeechobee compared to 2050 future-without-project (Table 5-24). In addition, backpumping values into Lake Okeechobee would be less, reducing loading from canals containing primarily agricultural run-off (Table 5-25). The project reduces backpumping by a total volume (over 36 years) of 100,000 acre-feet.

TABLE 5-24: HABITAT UNITS FOR LAKE OKEECHOBEE HIGH WATER PERFORMANCE MEASURES (PMS) (LO-E3 AND LO-E10 SA) FOR THE FIVE WETTEST YEARS FROM THE MODELING PERIOD OF RECORD.

	2000B3	2050B3	NAIS5a
HUs using high water PMs, wettest years	41760	42004	56605

TABLE 5-25: VOLUME OF BACKPUMPING IN ACRE-FEET FROM THE EVERGLADES AGRICULTURAL AREA INTO LAKE OKEECHOBEE THROUGH THE S-2 AND S-3 PUMP STRUCTURES FOR EAASR PROJECT ALTERNATIVES.

	2050B3	NAIS5a
S2 total ac-ft	334,497	240,456
S3 total ac-ft	87,484	81,328
Total Volume ac-ft	421,981	321,784

5.6.2 St. Lucie Estuary NAI Performance

Lake Okeechobee Regulatory releases (LORR) were the only RECOVER performance measure that demonstrated a significant change with project implementation for the St. Lucie Estuary (Table 5-26). On a next-added incremental basis, the project will contribute 259 AAHUs to the St. Lucie Estuary be reducing regulatory releases.

TABLE 5-26: HABITAT UNITS FOR ST. LUCIE ESTUARY FOR PERFORMANCE MEASURE OF REDUCTION IN LAKE OKEECHOBEE REGULATORY RELEASES (LORR) FROM THE MODELING PERIOD OF RECORD.

St. Lucie Estuary HUs	2000B3	2050B3	NAI-S5a
LORR PM	9	18	277

5.6.3 Caloosahatchee NAI Performance

For the Caloosahatchee Estuary, at low flow rates (<300 cfs) and at optimal flow rates (300-1500 cfs) the NAI-S5A alternative performs slightly worse than the 2050B3 (Table 5-27) (186 events compared to 167 events, and 113 events compared to 125 events, respectively). This slight decline in performance is expected, since Lake Okeechobee discharges will be stored in the reservoir instead of the C-43 Canal and basin. Furthermore, as a result of further study in the basin (notably, the Caloosahatchee Water Management Plan) there has been a reduction in the volume of runoff from the C-43 basin originally thought to be available for capture, storage, and delivery to meet environmental targets in the Caloosahatchee Estuary. This reduction is not a function of EAA project implementation. Without a significant modification to proposed project operations, the reservoir can not be operated to provide an additional source of water to meet salinity targets in the Caloosahatchee Estuary.

TABLE 5-27: CATEGORIZED DATA FOR THE CALOOSAHATCHEE ESTUARY PERFORMANCE MEASURE.

	2000B3	2050B3	NAI-S5a
<300 cfs	177	167	186
300-500	30	41	30
500-800	28	30	34
800-1500	50	54	49
1500-2800	65	57	64
2800-4500	45	45	40
>4500	37	38	29

However, during high flow rates (>2800 cfs), when the reservoir is used to provide storage of Lake Okeechobee water, the selected alternative performs slightly better than the 2050B3 (69 events compared to 83 events, respectively). However, none of these alternatives are significantly different from the others.

5.6.4 Ridge and Slough and Tree Island NAI Performance

Ridge and slough and tree island ouputs were not calculated for the next-added increment model run due to difficulties of modeling rain-driven operational triggers in the Everglades. Initial model runs indicate that the rain-driven triggers sometimes cause additional water to be imported into the WCAs at times when modeled water levels are already high to ensure that stage recession in those areas follows NSM-like patterns. However, the performance measures used to calculate ridge and slough and tree island habitat units would score such effects negatively. Therefore, it was determined to take a conservative analytical approach and not quantify next-added incremental habitat unit outputs for these indicators for this revised draft PIR/EIS. Instead, the operating plan calls for releasing the water stored in the reservoir when stages in the WCAs indicate that additional water should be provided to those areas based on monitoring and adaptive management principles.

5.7 JUSTIFICATION OF THE TENTATIVELY SELECTED PLAN (TSP) ON A NEXT-ADDED INCREMENT (NAI) BASIS

Section 385.9 ("Implementation Principles") of the CERP Programmatic Regulations required that "individual projects shall be formulated, evaluated, and justified based on their ability to contribute to the goals and objectives of the Plan and on their ability to provide benefits that justify costs on a next-added increment basis." The EAA Storage Reservoirs project's contribution to the goals and objectives of the CERP were evaluated by quantifying the increase in environmental benefits (habitat units) in Lake Okeechobee, the Caloosahatchee and St. Lucie Estuaries, and the ridge and slough and tree island communities in the Water Conservation Areas with all of the rest of the CERP compared to future without-project conditions. As expected, although the with-project next-added incremental performance was improved for Lake Okeechobee and the estuaries, the magnitude of the improvement was not as great as that calculated for the system formulation.

One simple additional measure of next-added incremental justification is the relative cost-effectiveness of above-ground storage in the CERP capable to store regulatory releases from Lake Okeechobee and act as a source of additional environmental water supply to the WCAs and Everglades National Park. The EAA Storage Reservoirs project (360,000 ac. ft. of storage capacity) will provide approximately one-fifth of all of the above-ground storage capacity included in the CERP (1,543,270 ac. ft.), and a large fraction of the total storage capacity in

the CERP can not function as source of additional water to the WCAs or ENP without extensive modification and likely substantially increased cost (compared to original designs and cost estimates).

Furthermore, since the land for this project has already been acquired by the Federal Government and the State of Florida for ecosystem restoration in South Florida, and further considering that implementation of additional storage at the project location will immediately result in the ability to reduce the harmful effects of high water levels on the littoral zone in Lake Okeechobee and reduce the magnitude and frequency of regulatory releases from to the Caloosahatchee and St. Lucie estuaries, the immediate, independent beneficial effects of the EAA Storage Reservoirs project justify project implementation, even if no other CERP projects are authorized or implemented. In fact, the need for additional regional storage at this location to accomplish these objectives is so acute that the State of Florida has begun advance design and construction work on a component of this project through its "Acceler8" program; initial construction on the Acceler8 project is scheduled to begin in 2006.

5.7.1 Risk and Uncertainty

As noted in section 5.4.2.1.4.1, once existing constraints on operations are reduced and/or eliminated such that additional water could be delivered in a manner consistent with restoration goals, total volumes of water made available by the EAA Reservoir project for introduction to the Everglades Protection Area are anticipated to be greater than existing levels. Because the volumes of water delivered into the Everglades Protection Area under “restored” conditions are likely to be greater than existing volumes, it is possible that additional STA optimization and/or capacity might be required to handle the additional hydraulic and nutrient loading rates associated with CERP-like deliveries. The potential need for additional STA optimization and/or capacity is being investigated including development of Planning level cost estimate in the Final PIR

5.8 TRADE-OFF ANALYSIS

Habitat units were weighed equally and summed to arrive at total habitat unit outputs for each alternative. This method takes into consideration the trade-offs in environmental performance for each of the natural system areas evaluated to achieve the best possible overall beneficial effect that can be achieved with a single optimized reservoir plan.

This page intentionally left blank

SECTION 6
THE SELECTED ALTERNATIVE PLAN

This page intentionally left blank

6.0 THE SELECTED ALTERNATIVE PLAN

The Selected Plan, Alternative 4, features a reservoir impoundment with a maximum normal pool storage depth of 12 feet at approximately 31,000 acres of above ground surface area storage. The reservoir is divided into two cells, Cell 1 and Cell 2, approximately 17,000 and 14,000 acres in size, respectively. Both reservoir cells include individual inflow pump stations, discharge structures, emergency overflow spillways, and seepage control canals with associated structures. Total acreage required for the reservoir and seepage control canals is 31,640 acres. After Alternative 4 was selected as the recommended plan, the design was optimized to exclude Section 13, Township 46 South, Range 35 East consisting of 640 acres and to add seepage canals to the south and west. The exclusion of Section 13 was due to its location in the northwest corner and the fact that to include the Section would require the construction of three miles of levee and seepage canal with an increase in storage capacity of approximately 7,680 acre feet. Excluding the Section would reduce the levee and seepage canal construction by two miles thereby reducing the costs of the reservoir without significantly reducing the planned capacity. The reservoir may provide opportunities to increase flood damage reduction capabilities through operational changes to the C&SF Project and local drainage systems. Additionally, the reservoir may provide limited water quality improvements. A stormwater treatment area comprised of approximately 1,495 acres is proposed east of the Miami Canal and west of the reservoir.

For the purposes of plan formulation and in accordance with the language of the Programmatic Regulations, the term "selected plan" refers to the alternative that has been selected for recommendation of implementation. For the purposes of complying with the National Environmental Policy Act (NEPA) and in the spirit of NEPA, the plan that would be recommended for authorization is termed the "preferred alternative". For NEPA, a plan is not "selected" until it has been fully coordinated, is subject to alterations based on public involvement, and is then formerly accepted by Congress or the Chief of Engineers, as appropriate, and authorized with the signing of a ROD or FONSI. Throughout this document, the analysis includes the NEPA evaluation, and uses the term "selected alternative" or "selected plan" interchangeably as the preferred alternative. "Selected" throughout this document is meant to discern which alternative is recommending to Congress or Chief of Engineers for further development and implementation.

6.1 DESCRIPTION OF PLAN COMPONENTS

The Study Area is located in western Palm Beach County, in the southern portion of the EAA, south of Lake Okeechobee and west of Water Conservation Area 1 and Water Conservation Area 2. The project site is a total of approximately 33,135 acres of land needed for the footprint of the selected plan,

including the reservoir, stormwater treatment area (STA), structures, and canals and is located north of the Holey Land WMA and STA 3/4, west of the North New River Canal, and east of the Miami Canal. The Study Area offers the distinct advantage of close proximity to both the North New River and Miami Canals and an existing canal conveyance network. A site location map of the project area is shown below in Figure 6-1.

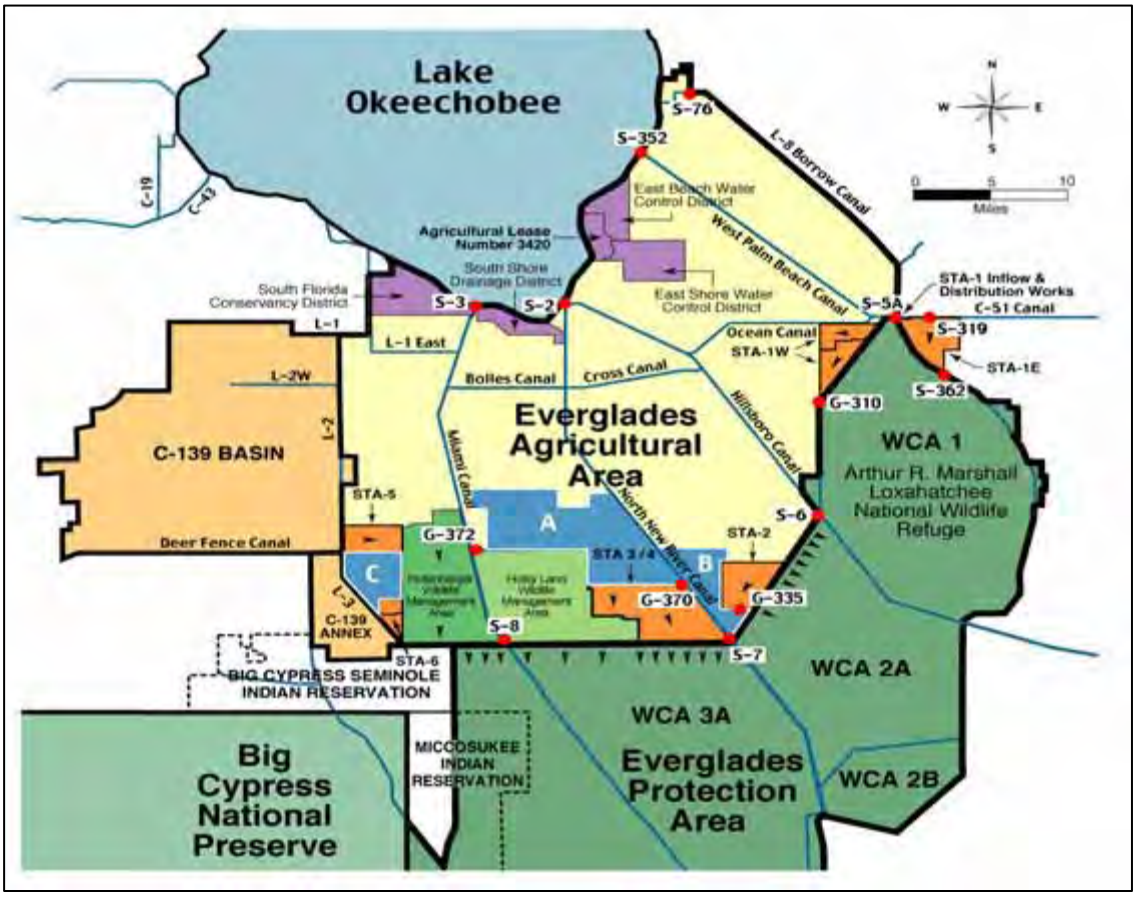

FIGURE 6-1: PROJECT AREA

The purpose of the Project is to store runoff from the EAA and discharges from Lake Okeechobee. Water stored in the reservoir will be used to meet EAA irrigation demands and to provide an additional source of water to meet environmental demands in the ridge and slough Everglades habitat in WCAs 2 and 3. Under normal conditions, water will be delivered from the project to the WCAs via STA 3/4 (part of the Everglades Construction Project). The reservoir will improve the performance of STA 3/4 by acting as surge tanks to equalize flows. The EAA reservoir and STA will also improve water quality by providing residence time for settling of contaminants prior to input into STA 3/4.

The reservoirs will augment and enhance other regional CERP projects as well as the SFWMD Long-term Plan, SFWMD Everglades Regulatory Program, and SFWMD Adaptive Management Strategy.

The Project is an integral part of the CERP. Ecological restoration of the Everglades will require a significant increase in the quantity of water made available or retained for the natural system. The goals of the Project are: improve timing of environmental deliveries to the WCAs including reducing damaging flood releases from the EAA to the WCAs, reduce Lake Okeechobee regulatory releases to the Caloosahatchee and St. Lucie Estuaries, and meet supplemental agricultural and environmental demands for water supply.

Design efforts are reviewing various combinations of reservoir footprint and pool depths while seeking to maximize the project benefits while minimizing the overall costs. The current storage reservoir project is being planned for Compartment A that lies between the Miami Canal and North New River Canal. The design elevations for the reservoir and each cell are shown on Table 6-1, Table 6-2 and Table 6-3 respectively. The design layout is shown in Figure 6-2.

TABLE 6-1: RESERVOIR DESIGN ELEVATIONS

Parameter	Height (Feet)
Top Of Levee	23.0
Maximum Surcharge Pool	16.3
Maximum Normal Pool	12.0

TABLE 6-2: CELL 1 RESERVOIR STORAGE CALCULATIONS

Cell 1	
Storage Area	+ 17,000 acres
Maximum Normal Pool Depth	12 feet
Storage	+ 200,000 ac-ft
Fill Rate at 3,900 cfs	0.5 ft/day
Time to Fill 4 feet at 3,900 cfs	8.8 days
Drawdown Rate at 4,000 cfs	0.5 ft/day
Time to Drawdown 4 feet at 4,000 cfs	8.6 days

TABLE 6-3: CELL 2 RESERVOIR STORAGE CALCULATIONS

Cell 2	
Storage Area	+ 14,000 acres
Maximum Normal Pool Depth	12 feet
Storage	+ 160,000 ac-ft
Fill Rate at 3,000 cfs	0.4 ft/day
Time to Fill 4 feet at 3,000 cfs	9.4 days
Drawdown Rate at 4,000 cfs	0.6 ft/day
Time to Drawdown 4 feet at 4,000 cfs	7.0 days

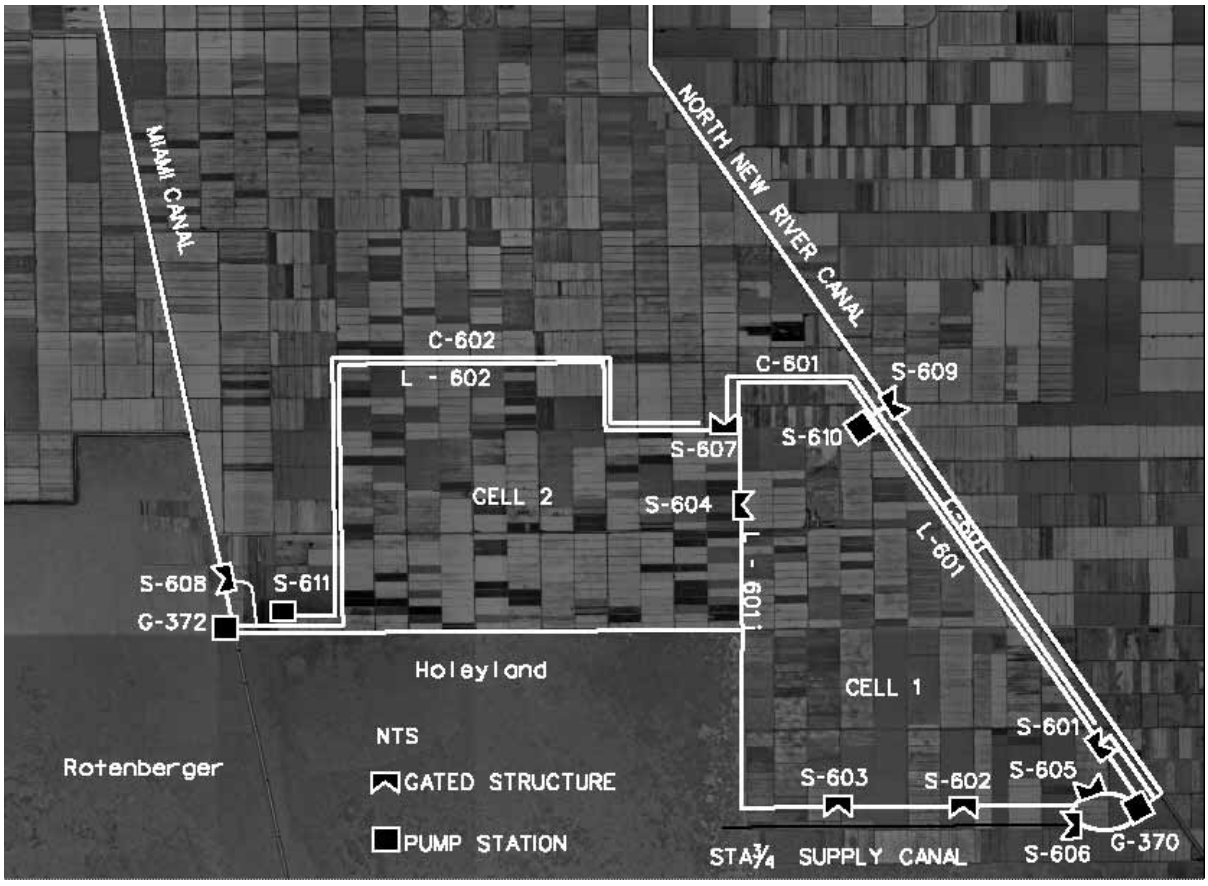

FIGURE 6-2: DESIGN LAYOUT

Note: The Design Layout does not show the location of the Proposed STA.

6.1.1 Features

The Project has the following features:

1. Pump Stations
   - S-610
   - S-611
   - Modified G-372
   - Modified G-370

2. Structures
   - S-601 through S-609 Gated Culverts

3. Canals
   - C-601 Canal (Cell 1 Borrow/Seepage/Conveyance)
   - C-602 Canal (Cell 2 Borrow/Seepage Canal)
   - Improved North New River Canal

- Improved Miami Canal
- Improved Supply Canal
- Improved Bolles and Cross Canals

4. Levees
   - L-601 Levee (Cell 1 Perimeter Levee)
   - L-601i Levee (Internal Levee separating Cells 1 and 2)
   - L-602 Levee (Cell 2 Perimeter Levee)

Stormwater Treatment Area
Approximately 1,495 acres of land already owned by the State of Florida and the South Florida Water Management District adjacent to and in the southwest corner of the reservoir has preliminarily been identified as the site for the stormwater treatment area.

6.1.2 Pump Stations

6.1.2.1 S-610 Pump Station

S-610 is the reservoir inflow pump station with a total pumping capacity of 2,505 cfs and is located on the east side of Cell 1 on the North New River Canal. The pump station is designed to capture runoff and Lake Okeechobee releases in the North New River Canal. S-610 is a 9-bay pump station with six 360 cfs diesel engine driven pumps and three 115 cfs electric motor driven pumps. All six diesel engine driven pumps are used during maximum flood control operations. The 115 cfs and 360 cfs pumps can be used to backpump seepage and maintain the perimeter seepage canal levels during non-runoff event times. Although electric motor driven pumps are presented for seepage pumping, for operational flexibility, any combination of pumps can be used to maintain optimum seepage canal levels.

6.1.2.2 S-611 Pump Station

The S-611 is a seepage collection pump station for Cell 2. This pump station pumps water from the seepage canal, C-602. S-611 is a four bay pump station with two 300 cfs diesel engine driven and two 100 cfs electric motor driven pumps. The pump station provides a total pumping capacity of 800 cfs. It is located near the southwestern corner of Cell 2 near existing pump station G-372. For operational flexibility, either one electric motor driven pump or both can be used to maintain optimum seepage canal levels.

6.1.3 Gated Culverts

6.1.3.1 S-601 Gated Culvert Structure

The structure is the outlet for Cell 1 into the North New River Canal and is located near the southeastern corner of Cell 1 just north of the G-370 pump station. S-601 is a two barreled, gated box culvert structure. The design flow is 2,000 cfs with a design head of 3.5 feet. The culvert barrels are typical box culverts with dimensions of 10 feet in height, 10 feet in width and 200 feet in length. The barrel invert is set at elevation –1.0 ft-NGVD. The structure will discharge into an outlet channel and into the North New River Canal via the existing bridge that serves the G-370 pump station.

6.1.3.2 S-602 and S-603 Gated Culvert Structures

These structures are the outlet for Cell 1 into STA 3/4. S-602 and S-603 are four barreled, gated box culvert structures. The design flow is 3,000 cfs with a design head of 2.5 feet. The culvert barrels are typical box culverts with dimensions of 10 feet in height, 10 feet in width and 200 feet in length. The barrel invert is set at elevation 1.0 ft-NGVD. S-602 and S-603 are located on the southern Cell 1 levee just north of the STA 3/4 supply canal. The structures will discharge into the STA 3/4 supply canal and then into STA 3/4 via existing gated structures G-374 A-F, G-377 A-E and G-380 A-F.

6.1.3.3 S-604 Gated Culvert Structure

The structure is an interior bi-directional structure that hydraulically connects reservoir Cells 1 and 2. S-604 is a three barreled, gated box culvert structure. The design flow is 2,000 cfs with a design head of 2 feet. The culvert barrels are typical box culverts with dimensions of 10 feet in height, 10 feet in width and 200 feet in length. The barrel invert is set at elevation 0.0 ft-NGVD. S-604 is located in the internal reservoir levee (L-601i) between Cells 1 and 2.

6.1.3.4 S-605 Gated Culvert Structure

The structure is an inlet structure from North New River Canal into Cell 1. Pump Station G-370 will pump from North New River Canal into a ring levee. When the stage in the ring levee is sufficient for making discharges, the gates from S-605 will be opened to release flows into Cell 1. S-605 is a three barreled, gated box culvert structure. The design flow is 2,000 cfs with a design head of 1.5 feet. The culvert barrels are typical box culverts with dimensions of 10 feet in height, 10 feet in width and 200 feet in length. The barrel invert is set at elevation 0.0 ft-NGVD. S-605 is located in the ring levee near the south eastern corner of Cell 1.

6.1.3.5 S-606 Gated Culvert Structure

The structure is an inlet structure from North New River Canal into STA 3/4. Pump Station G-370 will pump from North New River Canal into a ring levee. When the stage in the ring levee is sufficient for making discharges, the gates from S-606 will be opened to release flows into the STA 3/4 supply canal. S-606 is a two barreled, gated box culvert structure. The design flow is 2,000 cfs with a design head of 2 feet. The culvert barrels are typical box culverts with dimensions of 10 feet in height, 10 feet in width and 200 feet in length. The barrel invert is set at elevation 1.0 ft-NGVD. S-606 is located in the ring levee near the south eastern corner of Cell 1.

6.1.3.6 S-607 Gated Culvert Structure

The structure is the outlet for Cell 2 into the North New River Canal. The structure will discharge into the Cell 1 seepage canal (C-601 north) and into the North New River Canal via gated structure S-609. S-607 is a two barreled, gated box culvert structure. The design flow is 2,000 cfs with a design head of 3.5 feet. The culvert barrels are typical box culverts with dimensions of 10 feet in height, 10 feet in width and 200 feet in length. The barrel invert is set at elevation –1.0 ft-NGVD. Structure S-607 is located near the northeastern corner of Cell 2.

6.1.3.7 S-608 Gated Culvert Structure

The structure is the outlet for Cell 2 into the Miami Canal. S-608 is a two barreled, gated box culvert structure. The design flow is 2,000 cfs with a design head of 3.5 feet. The culvert barrels are typical box culverts with dimensions of 10 feet in height, 10 feet in width and 200 feet in length. The barrel invert is set at elevation –1.0 ft-NGVD. S-608 is located near the southwestern corner of Cell 2 just north of the G-372 pump station. The structure will discharge into an outlet channel and into the Miami Canal via the existing bridge that serves the G-372 pump station.

6.1.3.8 S-609 Gated Culvert Structure

The structure is a bi-directional inlet and outlet structure that hydraulically connects the EAA reservoir to North New River Canal. S-609 is a six barreled, gated box culvert structure. The design flow is 2,000 cfs with a design head of 0.5 feet. The culvert barrels are typical box culverts with dimensions of 10 feet in height, 10 feet in width and 300 feet in length. The barrel invert is set at elevation –1.0 ft-NGVD. S-609 is located near the northeastern corner of Cell 1 near pump station S-610. This structure will be constructed underneath U.S. Highway 27.

6.1.4 Existing Structures

6.1.4.1 G-370 Pump Station

G-370 is an existing pump station that is currently being used as the STA 3/4 inflow. Stormwater runoff and Lake Okeechobee releases in the North New River Canal pass underneath the bridge on US 27 through this pump station and into the STA ¾ distribution system. For the EAA Storage Reservoir Project, this pump station will be used as the reservoir Cell 1 inflow as well as inflow to STA 3/4. This is a six bay pump station with three 925 cfs diesel pumps and three 75 cfs electric driven seepage pumps. The total flood control capacity is 2,775 cfs. For the EAA Storage Reservoir Project, the capacity of G-370 will be reduced to approximately 2,000 cfs due to the increase in head required. The pump station is located at the southeastern corner of Cell 1 adjacent to U.S. Highway 27 and the North New River Canal.

6.1.4.2 G-372 Pump Station

G-372 is an existing pump station that is currently being used as the STA 3/4 inflow. Stormwater runoff and Lake Okeechobee releases in the Miami Canal pass through this pump station and into the STA 3/4 distribution system. For the EAA Storage Reservoir Project, this pump station will be used as the reservoir Cell 2 inflow structure. This is a seven bay pump station with four 925 cfs diesel engine driven pumps and three 75 cfs electric driven seepage pumps. The total flood control capacity is 3,700 cfs. For the EAA Storage Reservoir Project, the capacity of G-372 will be reduced to approximately 3,000 cfs due to the increase in head required. The pump station is located at the southwestern end of Cell 2 adjacent to the Miami Canal.

6.1.4.3 G-374 A-F, G-377 A-E and G-380 A-F Gated Culverts

Existing control structures G-374 A-F, G-377 A-E and G-380 A-F are a series of six, five, and six barreled gated box culvert structures, respectively. Flows from the Miami and North New River Canals are conveyed through the STA 3/4 supply canal and distributed through these control structures into STA 3/4. The total capacity for these structures is approximately 6,000 cfs. The structures are double-barreled stop log riser structures. For the EAA Storage Reservoir Project these structures will continue to function as the STA 3/4 inflow structures. These structures are located along the northern boundary of STA 3/4.

6.1.5 Canals

6.1.5.1 Perimeter Canal

The functions of perimeter canals, C-601 and C-602, are for seepage collection and conveyance of reservoir outlet flows. The canals are also required as a borrow source for construction of levees. The new perimeter canals will capture seepage to the western, northern, and eastern boundaries. Seepage along the reservoirs southern boundary will be captured by the existing STA 3/4 supply canal.

6.1.5.2 C-601 Canal

Canal C-601 is the Cell 1 perimeter seepage/conveyance canal. The canal is located along the Cell 1 northern and eastern boundaries. The north section of C-601 is used for both seepage collection and conveyance of Cell 2 discharge through the S-607 structure. The eastern reach of C-601 is used for seepage collection. Seepage flows in the canal are collected by the S-610 pump station and returned to the reservoir.

6.1.5.3 C-602 Canal

Canal C-602 is the Cell 2 perimeter seepage canal. The canal is located along the Cell 2 northern and western boundaries. The north section of C-601 is used for both seepage collection and conveyance of Cell 2 discharge through the S-607 structure. The eastern reach of C-601 is used for seepage collection.

6.1.6 Canal Modifications

6.1.6.1 Miami Canal

The design capacity of the Miami Canal is 3,000 cfs. The conveyance capacity of the Miami Canal would have to be increased by approximately 50% as determined by the hydraulic analysis. The increase in capacity requirements necessitated an enlargement of an approximate 9 mile section of canal. All of this work will be performed within the existing SFWMD right of way of the Miami Canal.

6.1.6.2 North New River Canal

The design capacity of the North New River Canal is 4,000 cfs. The conveyance capacity of the North New River Canal would have to be increased by approximately 150% as determined by the hydraulic analysis. The increase in capacity requirements necessitated an enlargement of an approximate 22.5 mile section of canal between the reservoir and Lake Okeechobee. The North New

River Canal channel improvement is constrained by U.S. 27 on the west bank. All of this work is planned to be performed within the existing SFWMD right of way of the North New River Canal

6.1.6.3 Bolles and Cross Canals

Improvements to the Bolles and Cross Canals will allow water from Lake Okeechobee and the northern portion of the EAA to be more effectively routed to the south. The design capacity determined for these canals is 1,500 cfs. The existing capacities of these canals are severely limited due to their shallowness. The increase in capacity requirements necessitated an enlargement of the entire reach of both canals. The length of Bolles and Cross Canals are approximately 7.7 and 8.8 miles, respectively. All of this work will be performed within the existing SFWMD right of way of the Bolles and Cross Canals. The location of the Bolles and Cross Canals are shown on Figure 6-3.

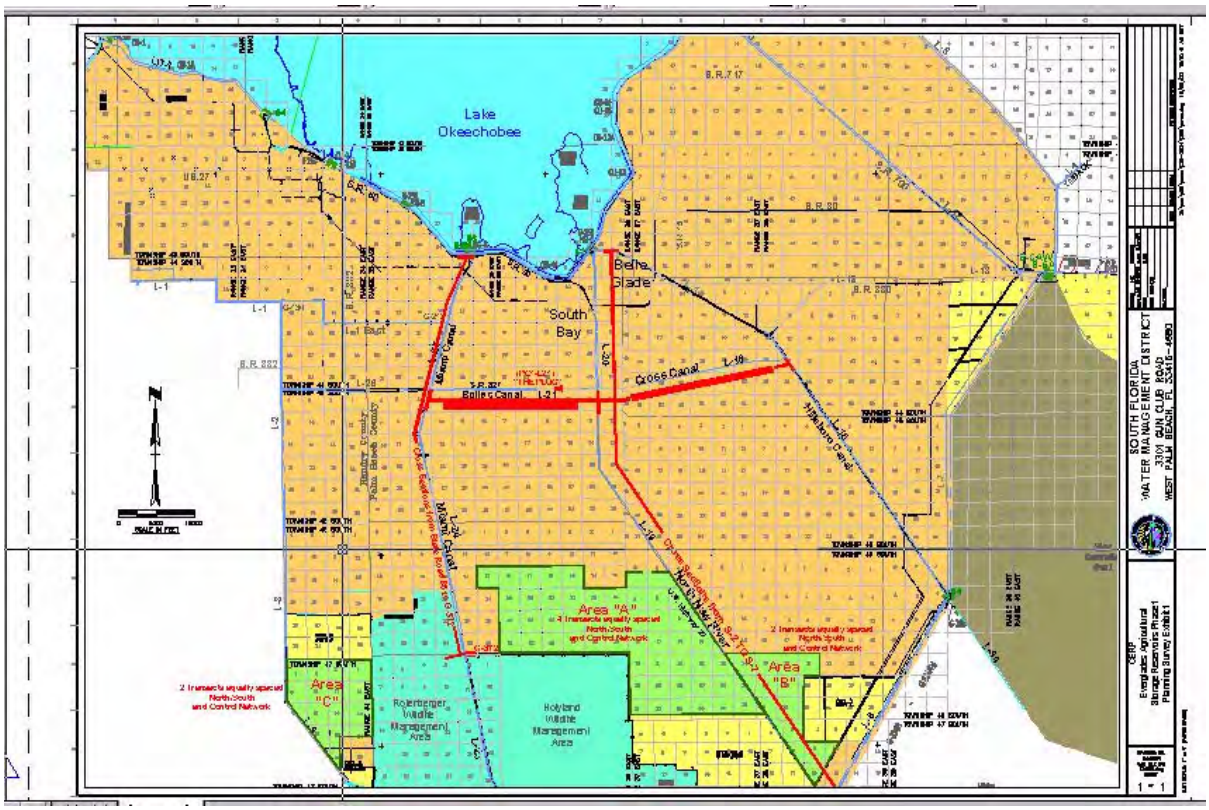

FIGURE 6-3: BOLLES AND CROSS CANALS

6.1.7 Levees

The reservoir has perimeter levees, L-601 and L-602, with a minimum height of 23 feet above average ground for both earthen and RCC designs. The height of the internal levee L-601i is 21 and 19.2 feet above average ground for the earthen and RCC designs, respectively.

Cut-off walls will be installed as part of the levee or embankment construction. For earthen embankments, the estimated depth of the cut-off wall is 35 feet along the east, north, west, and STA3/4 sides of the reservoir. A 50-foot deep cut-off wall will be installed along the Holey Land area.

6.1.8 Bridges

The S-609 box culvert structure will be constructed underneath U.S. Highway 27. This structure will serve as a hydraulic connection between the EAA reservoir and the North New River Canal. More detail on structure S-609 is provided in Section A-2.4.2.2.1.2 and Plate C-5 in the Engineering Appendix (Appendix A).

Bridge relocations/replacements will be required due to channel improvements in the Miami, North New River, Bolles and Cross Canals. Improvements to the Miami Canal will necessitate the replacement of 2 bridges. Improvements to the North New River Canal will necessitate the replacement of 7 bridges. Improvements to the Bolles Canal will necessitate the replacement of 3 bridges. Improvements to the Cross Canal will necessitate the replacement of 5 bridges.

6.1.9 Stormwater Treatment Area

Operation of the EAA Storage Reservoir selected plan involves capturing and storing regulatory releases from Lake Okeechobee and runoff from the Everglades Agricultural Area and subsequently delivering the stored water for both water supplies to the Everglades Agricultural Area and to meet hydrologic targets in the WCAs and Everglades National Park. Although the selected plan works in concert with STA 3/4, it is anticipated that the additional hydraulic and phosphorus loading associated with delivering additional water to the WCAs and Everglades National Park to meet hydrologic targets will occasionally exceed the treatment capacity of STA 3/4. To ensure that water that is to be delivered to the WCAs and Everglades National Park meets water quality requirements, a conceptual STA is included in the EAA Storage Reservoir selected plan.

Approximately 1,495 acres of land already owned by the State of Florida and the South Florida Water Management District adjacent to and in the southwest corner of the reservoir have been identified as the likely site for the STA. Additional analysis will be conducted prior to the Final PIR and during the detailed engineering and design phase of the project to refine the design, cost, and operations of this storm water treatment area. Sizing and optimization of the proposed STA may include converting a portion of Cell 2 to a STA as well.

6.1.10 Other Features

6.1.10.1 Wetlands Buffer

A 200-foot buffer area runs along the east, north, and western boundaries of the reservoir. This seepage buffer will extend 200 feet from the base of the embankment. It will provide both seepage control and wildlife habitat within the project footprint, encompassing a total of 560 acres. The design of the buffer is to mimic an upland-wetland mosaic and allow for maintenance of the reservoir embankment (Table 6-4). The first 50 feet of the buffer will be an upland maintenance corridor. From 50 to 100 feet, the buffer area would be regarded post-construction to the existing grade and allowed to re-vegetate naturally as a wetland. From 100 to 200 feet, the buffer area would contain a deeper (-2 feet elevation from existing) excavated wetland interspersed with tree islands sloped to 4 feet above existing grade. Tree islands will be approximately 50 feet wide, and occupy approximately 75% of the total length of linear feet of buffer area. Therefore, approximately 95 acres of tree island habitat will be provided within the buffer. Wetlands created and restored in the buffer footprint will be approximately 404 acres of wetland habitat. The wetland portions would be hydrated by rainfall, seepage from the reservoir, and perhaps groundwater "backed up" from the cut-off walls. The elevated tree islands will be planted with native tree vegetation of appropriate species. See Figure 6-4 for a conceptual cross section.

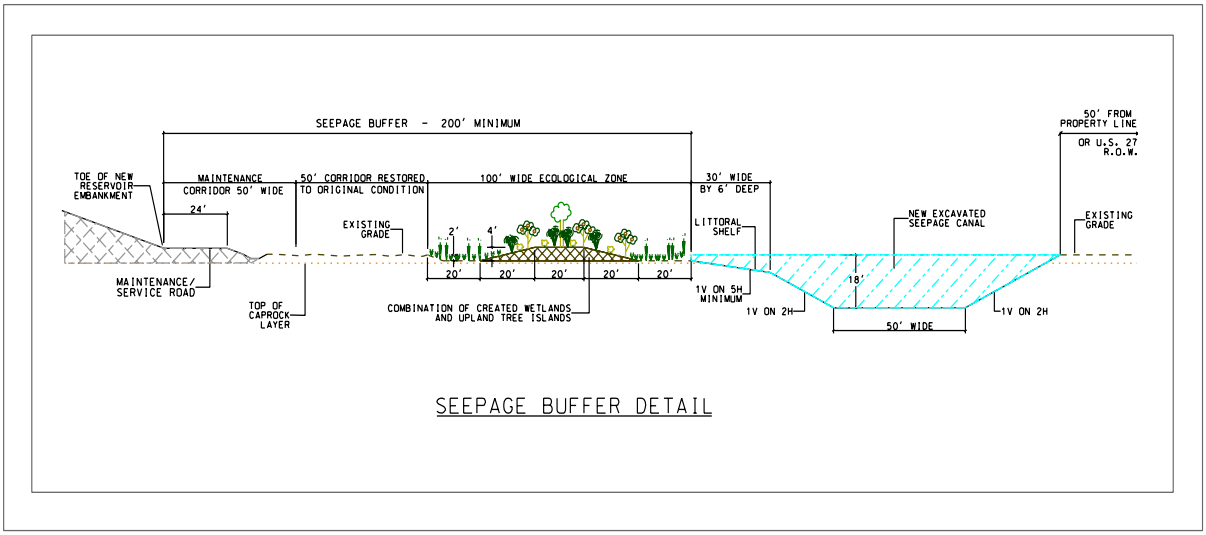

FIGURE 6-4: CONCEPTUAL CROSS-SECTION OF THE EAA PROJECT FOOTPRINT INCLUDING THE SEEPAGE/HABITAT BUFFER AND LITTORAL SHELVES

TABLE 6-4: WETLANDS BUFFER AND LITTORAL ZONE

Feature	Wetland	Upland	Littoral Shelf	50' Corridor to Eventually Return to Wetland
Ave. Width (ft)	60	50	30	50
Length (lf)	110,000	82,500	110,000	110,000
Area (Acres)	152	95	76	126
Totals	278	95	76	

Notes:
1. Wetland and Upland average width is calculated by assuming an average depth of 1 foot. Which results in an average Wetland strip width of 60 linear feet and 50 linear feet Upland.
2. It is assumed that the Seepage Buffer will occur all along the east, north, and west sides of the project site for a total length of 110,000 linear feet.
3. It is assumed that the upland (tree islands) will occupy only 75% of the total length since it takes 25% more material from the excavated wetland to built each linear foot of upland (i.e. there will be only 75 linear feet of upland for each 100 of wetland.)

6.1.10.2 Deep-water Refugia and Littoral Zone

Deep water refugia are created by the existing agricultural ditches and excavation borrow pits within the reservoir. The area of the borrow pits is approximately 170 acres. The existing ditches and borrow pits provides fish refuge during periods when the reservoir pool elevations approaches average ground elevation. The littoral zone will be located along the length of the seepage canal for approximately 110,000 feet. The shelf would be approximately 30 to 35-feet wide. The first 15-foot wide section would be contoured to a 1V:5H slope. Where the caprock intersects the littoral shelf it will be sloped to the extent practicable. The second 15-foot wide section would be contoured to a 1V:2H slope. The littoral shelves would be constructed by scraping the peat layer adjacent to the canals. The shelf should provide an estimated 76 acres of habitat for fish and wildlife, especially wading birds.

6.1.10.3 Recreation

The justification of incurring additional costs for recreation features is derived by utilizing a benefit to cost ratio. The detailed evaluation of these features is presented in Appendix D. Because the total recreation features (Figure 6-5) was the same for all action alternatives considered, only the selected alternative plan was evaluated in Appendix D. These average annual recreation benefits and costs are summarized in Table 6-5. The evaluation indicates there are 6.7 times more benefits than costs. The benefit to cost ratio for the recreation features equals 6.7 to 1, with net annual benefits equaling $185,700.

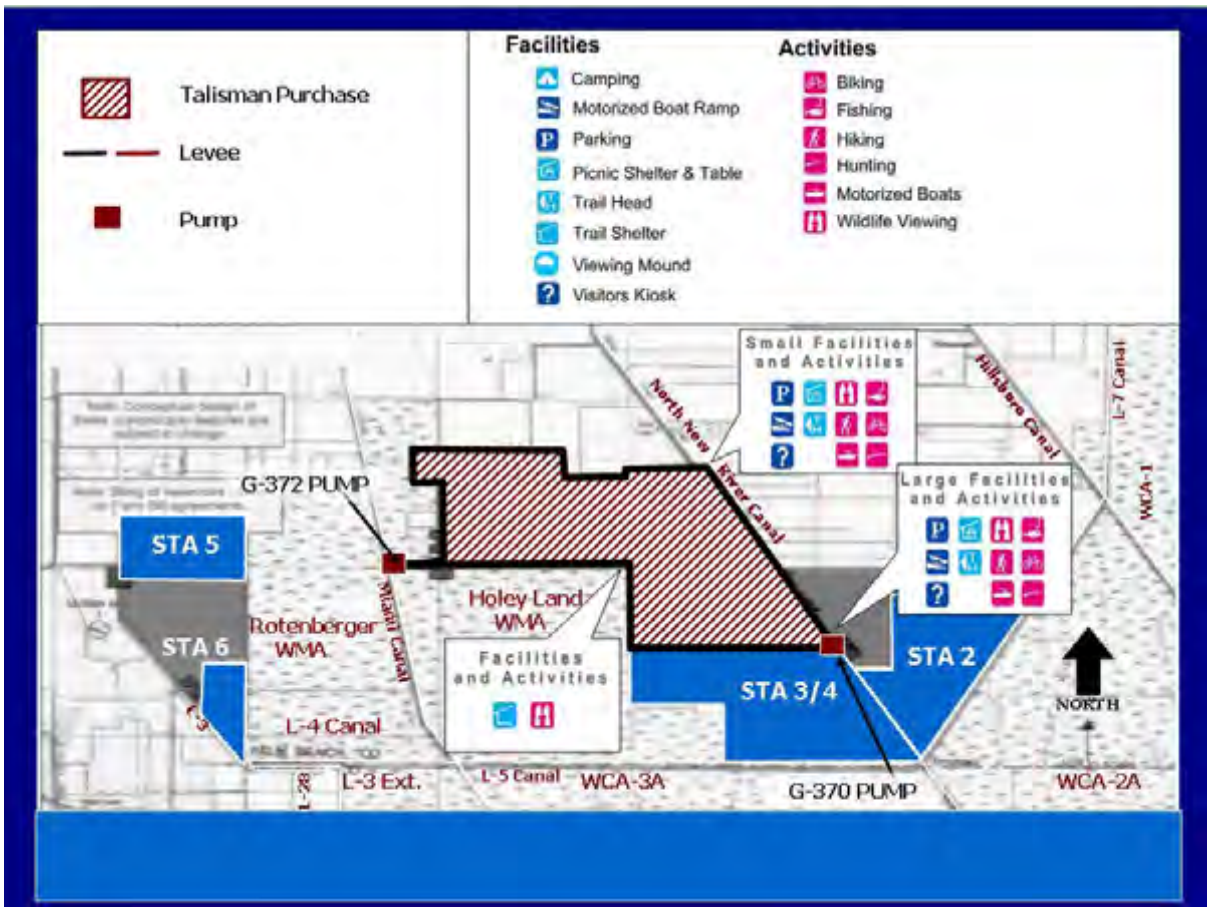

FIGURE 6-5: EVERGLADES AGRICULTURAL AREA CONCEPTUAL RECREATION PLAN

TABLE 6-5: SUMMARY OF RECREATION COSTS AND BENEFITS

Annual Costs	
Total Recreation Costs	$342,300
Interest during PED and Construction	$38,500
Total Investment Cost	$380,800
Average Annual Cost	$27,800
Interest	$23,100
OMRR&R	$4,700
Annual Benefits	
Unit Day Value	$5.85
Daily Use	100 users
Annual Use (100 users x 365 days)	36,500
Average Annual Benefit	$213,500
Benefit to Cost	6.7 to 1
Net Annual Benefits	$185,700

6.2 COST ESTIMATE

6.2.1 Initial Costs

The total estimated initial cost for the selected alternative plan is $912,895,089. This does not include any real estate, engineering, design or construction costs for the proposed stormwater treatment area, which will be included at a Planning level cost estimate in the Final PIR. Current rough order of magnitude costs for the proposed STA include an estimated real estate cost of $8,176,000 and cost estimates for construction ranging from $57,800,000 to in excess of $150,000,000, based on comparative costs of similar construction. The estimated cost of the selected alternative plan features, including real estate (lands and damages), is shown in Table 6-6**.**

TABLE 6-6: PROJECT COST EAA RESERVOIR ALTERNATIVE 4

Borrow and Canal	$261,957,593
Levee construction	$191,732,312
Cutoff Wall	$86,086,678
Utility Relocations	$323,857
Bridges	$5,636,497
NNR Canal Improvements	$35,443,519
Miami Canal Improvements	$16,682,354
Bolles & Cross Improvements	$20,745,203
Pump Stations	$122,520,842
Structures	$14,714,934
Manatee Gates	$5,325,000
Recreation	$342,300
Total Construction Cost	$761,511,089
Real Estate	$80,134,000
S&A	$33,750,000
PED	$37,500,000
Total Estimated Cost*	$912,895,089

*Real estate, engineering, design and construction costs for the STA have not been added to this table as a conceptual design has not been completed. Additional analysis will be conducted prior to the Final PIR and during the detailed engineering and design phase of the project to determine the final design, size, costs, and operations of the STA.

6.2.2 Investment Costs

Department of the Army Engineering Regulation (ER) 1105-2-100 requires that interest during construction (IDC) be computed which represents the opportunity cost of capital incurred during the construction period. Interest was computed for construction and pre-construction engineering and design (PED) costs from the middle of the month in which the expenditures were incurred

until the first of the month following the estimated construction completion date. Interest during construction is shown within Table 6-7.

TABLE 6-7: TOTAL INTEREST DURING CONSTRUCTION

COST COMPONENT	
Construction Features	$832,761,089
Real Estate	$80,134,000
Total Initial Cost	$912,895,089
Interest During Construction	
IDC Construction	$77,244,499
IDC Real Estate	$16,518,781
IDC Recreation	$31,766
Total Interest During Construction	$93,795,046

The cost of a project is the investment incurred up to the beginning of the period of analysis. The investment cost at that time is the sum of construction and other initial cost such as real estate and PED cost plus interest during construction. The IDC for the construction element of the selected alternative plan is $77,244,499.

Interest during construction was computed for real estate using the date the lands are to be certified for the project. The total IDC on real estate is estimated to be $16,518,781. The average annual water quality monitoring costs are estimated to be $350,000 (see Annex F).

6.2.3 Operation, Maintenance, Repair, Replacement, and Rehabilitation Costs

Annual operation and maintenance costs were estimated for the construction features of the selected alternative plan. The operation and maintenance costs were determined by extrapolation from operational cost histories supplied by the SFWMD, by using industry standard cost data and by using data from past and projected future cost trends. The average annual operation, maintenance, repair, replacement and rehabilitation (OMRR&R) costs are estimated to be $2,413,982 (Table 6-8).

TABLE 6-8: OMRR&R COST ESTIMATES

Item	Quantity	Estimated Annual Cost
Spillway (2000 cfs)	5	$ 245,000
Spillway (3000 cfs)	2	$ 112,000
New Pump Station (2,000 cfs)	1	$ 300,000
New Pump Station (3,000cfs)	1	$ 400,000
Embankment Maintenance		$ 108,871
Road Maintenance		$ 34,881
Invasive Plant Control - Reservoir		$ 555,717
Invasive Plant Control - Buffer Area		$ 47,575
Supervision & Monitoring		$ 605,238
Recreation Maintenance		$ 4,700
TOTAL		$2,413,982

6.2.4 Annual Costs

Investment costs were converted to annual costs using an interest rate of 5 1/8 percent and a period of analysis of 39 years to compute interest and amortization. Annual operation and maintenance costs and monitoring and adaptive assessment costs were then added to the interest and amortization costs to determine the average annual cost, which is $62,920,660 for the selected alternative plan (Table 6-9).

TABLE 6-9: AVERAGE ANNUAL COST

Interest and Amortization	$60,156,678
Operation & Maintenance	$2,413,982
Monitoring	$350,000
Total Annual Cost	$62,920,660

6.3 SELECTED ALTERNATIVE PLAN

Selected Alternative Plan Costs-Provide a general breakdown of all the costs associated with the selected alternative plan. Include costs for: construction; lands, easements, relocations, rights-of-way and disposals (LERRDs); operations and maintenance, repair, rehabilitation, and replacement (OMRR&R); and project monitoring (Table 6-10).

TABLE 6-10: SELECTED PLAN COSTS

COST COMPONENT	
Construction Features	$832,761,089
Real Estate	$80,134,000
Total Initial Cost	$912,895,089
Total Interest During Construction	$93,795,046
Total Project Investment	$1,006,690,135
Total Annual Equivalent Cost	$60,158,576

6.4 DESIGN AND CONSTRUCTION CONSIDERATIONS

6.4.1 Embankments and Canals

6.4.1.1 Reservoir Embankments

The embankments for the EAA Reservoir will be constructed in their entirety from materials found on the Project site. Earthen embankments will be constructed as "zoned" type embankments, see typical sections in Appendix A on Plates G-2 through G-4. This is defined as an embankment with zones of differing gradations. The center or the core of the embankment is made of a selected graded material that will provide the low permeability properties desired. Other zones surrounding the core (random fill) usually do not require the low permeable properties of the core, but need to be structurally stable. This type of zoned embankment construction will minimize the amount of processing required on the excavated material, hence, reducing the cost. Based on site geology, the core material will be obtained from the silty sand/limestone layer the lies below the caprock layer. It is believed that the material obtained from this layer will not need any processing to obtain the desired properties once in place. The random fill material, or the exterior layer of the embankments, is defined as the material to be obtained from the blasting of the top caprock layer, mixed with the additional silty sand/limestone materials material and any other surplus of suitable material obtained from the excavation operations. No specific processing is assumed for this type of material. However, rock blasting operations must be designed to produce the desired aggregate size which typically has a maximum particle size of 8 inches.

The reservoir embankments will be constructed with a 12-foot wide crest. Earthen embankments will have 1V on 3H slopes on both sides. A 20-foot wide maintenance/service road will be placed on the toe of the exterior side of the embankment. The road will be unpaved, and constructed with random fill material. The interior slopes of the exterior embankment, facing the inside of the reservoir, will be protected with riprap and soil-cement, while the outside slopes will be grassed. Some of the design features are presented below.

6.4.1.1.1 Wave Breaking Bench

A wave breaking bench will be constructed along the inside slope of both types of reservoir embankments. This wave-breaking bench will be constructed to an elevation 3 feet below the Maximum Surcharge Water Level. The bench will be 25 feet wide on the top, with 1V on 3H side slope. The wave-breaking bench will be constructed with random fill material and protected, see details.

6.4.1.1.2 RipRap Slope Protection

The interior face of the earthen reservoir embankment will be protected with a 24-inch thick layer of riprap revetment for erosion protection against wave action and water level fluctuation. The material for this riprap will come from blasting the caprock layer immediately below the superficial peat-silt layer overlaying the EAA area. The riprap revetment will cover the top sloped face of the embankment and the top of the wave breaking berm. The sloped face of the wave breaking berm will be protected with a 12-inch thick layer of soil-cement. Geotextile filter fabric will be placed under the riprap revetment layer.

6.4.1.1.3 Soil-Cement Slope Protection

The slope face of the wave breaking berm for the earth embankments will be protected by a 12-inch layer of cement treated soil. The soil will be select fill from the layer under the caprock. An approximate 12% Portland Cement will be added into the soil, together with a designed amount of water, mixed in a pug-mill, placed and compacted.

6.4.1.2 General Construction Considerations

6.4.1.2.1 General Embankment Foundation Preparation

The reservoir embankment foundation footprint should be cleared of the peat-silt layer, to the caprock. The embankment fill material will be placed and compacted directly over the caprock. About one foot of the caprock layer will be scrapped off to secure an even and stable foundation for the embankment.

6.4.1.2.2 Peat-Silt Layer

During excavation of the seepage collection canal, clearing of the embankment footprint and excavation of the borrow pits, a substantial quantity of peat-silt material will be generated. Although some of this material will be used in the creation of tree islands in the exterior seepage buffer, there will be a surplus of this type of material. The surplus material may be placed back into the borrow pits.

6.4.1.3 Seepage Canal and Seepage Buffer Area

6.4.1.3.1 Seepage Canal

Excavation of the seepage canal and borrow pits will require clearing of the peat-silt layer, followed by blasting of the caprock layer prior to the excavation of silty sand/limestone layer. The seepage canal is 50 feet wide at the bottom and 18 feet deep. The side slopes are 1V:2H. A 30-foot wide environmental littoral shelf

will be built on the reservoir side of the canal by scrapping of the peat layer with no additional blasting. The littoral shelf will be built at a 1V:5H slope for the first 15 feet and 1V:2H slope to the canal base. Where the caprock intersects the littoral shelf it will be sloped to the extent practicable. The seepage collection canal will be located along the exterior of the east, north and west sides of the reservoir.

6.4.1.3.2 Seepage Buffer

The seepage buffer will be a minimum of 200 feet wide, measured from the reservoir's edge of the service road to the beginning of the littoral shelf within the seepage canal. These areas will be provided with intermittent wetland and island zones to provide environmental benefits for fish and wildlife.

6.4.2 Structures/Structural Requirements

6.4.2.1 Design Criteria

6.4.2.1.1 Loading Conditions

Each standard design is developed to withstand usual, unusual, and extreme loading conditions. Usual loading conditions include loads most frequently experienced by the structural system when performing its primary function throughout its normal service life. Unusual loading conditions, such as construction or maintenance operations, produce short duration loads, and their occurrence is not frequent. Extreme conditions such as the standard project floods, and hurricane wind force is the worse case scenario; extreme loads represent the widest deviation from the usual and unusual loading conditions.

6.4.2.1.2 Stability

EC 1110-2-291 criteria are followed for the Stability Analysis of Concrete Structures, which includes the overturning, bearing, and sliding checks. A structure importance factor and site information factor of 1.0 has been assumed for design.

6.4.2.1.3 Concrete

EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures and ACI-318-99, Building Code Requirements for Structural Concrete are used for structural concrete design. A compressive strength of 3-ksi and yield strength of 60-ksi for tension reinforcement has been assumed for design.

6.4.2.1.4 Steel Sheet Pile

EM 1110-2-2504, Design of Sheet Pile Walls is used to design wing walls and cofferdams. Yield strength of 50-ksi has been assumed for sheet pile design.

6.4.2.1.5 Structural Steel

The Manual of Steel Construction, Allowable Stress Design, 9th Edition, is used to design swales and struts for cofferdams. Yield strength of 50-ksi is assumed for structural steel.

6.4.2.2 Culverts

6.4.2.2.1 General

The Project includes nine gated multi-barrel concrete box culverts. Proposed culvert structures are standardized to simplify their design, construction, and future operations and maintenance. At roadway crossings, culvert designs are in accordance with AASHTO and FDOT standards. Refer to the structural plates for the typical culvert arrangement, hydraulic design data, flow capacities and sizes.

The gated culverts will include precast reinforced concrete box culverts with a front gate monolith, rear headwall, and steel sheet pile wing walls. Foundations include typical bedding requirements. The gate wells include an operation platform to support the gate hoist mechanisms. Gate hoists include both local and remote controls. Separate head and tail water gage stations are installed adjacent to the structures. Stone protection is used for upstream and downstream channel erosion control.

Culvert installation is performed using the cut-and cover method, with sequential partitioned steel sheet pile cells. Cell sizes are limited by groundwater control using well point systems. Gate wells may require a sealed-bottom cofferdam system.

6.4.2.3 Pump Stations

6.4.2.3.1 General

Drawings have been provided in Appendix A to illustrate the main features of the two new pump stations, S-610 and S-611, with separate plates included to show typical plans and elevations for each station. Also included are the hydraulic data sheets with number of pumps, pumps sizes, and operational water surface levels.

6.4.2.3.2 Construction Materials

The superstructures for all pumping stations are constructed with reinforced concrete. For large pumping stations, the substructure is constructed with mass concrete. Substructures for medium and small pumping stations are constructed with reinforced concrete.

6.4.2.4 Bridges

The S-609 box culvert structure will be constructed underneath U.S. Highway 27. This structure will serve as a hydraulic connection between the EAA reservoir and the North New River Canal. More detail on structure S-609 is provided in Section A-2.4.2.2.1.2 and Plate C-5 in the Engineering Appendix (Appendix A).

Bridge relocations will be required due to channel improvements in the Miami, North New River, Bolles and Cross Canals.

6.4.3 Mechanical and Electrical Requirements

6.4.3.1 Utility Relocation

6.4.3.1.1 General

Since the EAA is located in a rural and largely undeveloped area in southwestern Palm Beach County, the need for utility relocation has been minimized. Conflicts with existing or proposed utilities have been avoided by design modification whenever possible. All known necessary utility relocations are detailed in Appendix A, since accounting for the impact of any construction interference is an essential part of project planning.

Conveyance canal improvements for the North New River canal will involve widening of the canal, and, because of this work, utility relocation is anticipated in conjunction with the replacement of two bridges. Fiber optic communication lines are attached to one bridge, and a water main to the other. Relocation of utilities attached to bridges will be included as part of the bridge construction project. A high voltage electrical transmission line, and an aerial electrical distribution line and telephone line will also require relocation due to canal improvements near Lake Okeechobee. Relocation of an overhead electrical distribution line and telephone line the crosses through the reservoir area is also anticipated. The need for additional required utility relocation may be found once pre-construction project survey information is available.

6.4.3.2 Mechanical Design

Pump Station General Information and Size Criteria
The new pumping stations of the Project shall be categorized as medium-sized. For the purpose of this study, a pump station is considered medium-sized if it has least one pump with a capacity greater than 75 cfs, and no pumps with a capacity greater than 450 cfs. By contrast, existing pump stations G-370 and G-372 are categorized as large pumping stations because the largest pumps in each station have 925 cfs capacity.

The pump stations shall be designed in accordance with Hydraulic Institute Standards, EM 1110-2-3102 (General Principles of Pumping Station Design and Layout), EM 1110-2-3105 (Mechanical and Electrical Design of Pumping Stations). The pumping stations will also follow the guidance of ETL 1110-2-313 (Hydraulic Design Guidance for Rectangular Sumps of Small Pumping Stations with Vertical Pumps and Ponded Approaches). The use of formed suction intakes and siphon discharges for the larger pumps at these stations shall be evaluated during preparation of the plans and specifications for each specific pumping station, and shall be based upon the channel intake design, the required pumping heads, and life cycle cost analysis.

It is assumed that mixed flow or vertical axial flow pumps will be used for all pumping stations. All of the pumps will be water-lubricated. The medium-sized pumping stations will be designed with vertical, axial flow pumps with either a horizontal or siphon type discharge. Pumping station criteria and information is located in Appendix A on Table A-33, EAA Pumping Station Information.

6.4.3.2.1 Medium-Sized Pumping Stations

Pumping stations categorized as medium-sized pumping stations are S-610 and S-611. S-610 is located along the North New River Canal and has a capacity of 2505 cfs, and S-611 is located along the Miami Canal and has a capacity of 800 cfs.

6.4.3.2.2 Pumps: Pumping Capacity, Pump Sizes, and General Information

The medium-sized pumping stations will have four and nine pumping systems. The pumps in each of the stations will be axial-flow-type vertical-shaft pumps. Power to the pumps will be provided by either diesel engines through right angle reduction gear drives or by direct-drive electric motors. Appendix A, Table A-33 lists the number of pumps, the capacities of the pumps, the drives, etc., for each of the pumping stations in the EAA.

Medium-sized pumping stations will be configured similar to that shown on Plates M-1 through M-6. Plates M-1 through M-3 show the plan and sections for four-bay pumping station S-611. Plates M-4 through M-6 show the other medium-sized pumping station, S-610, which is a nine-bay station. The pumps at both medium-sized pumping stations are expected to run at less than 500 rpm with an efficiency of about 80%. The diesel engine pump drives should be in a range of from 1330 to 1630 horsepower each. The electric motor pump drives should be 400 or 500 horsepower each.

Each of the medium-sized pumping stations will include various support items including the following:

1. Diesel fuel system, including vaulted double-wall aboveground fuel storage tanks capable of holding enough fuel to operate all of the engine driven pumps and the emergency generator continuously for 7 days. Day tanks shall be provided and sized to adequately supply the diesel engine pump drives and generator within the limitations of NFPA 37. The FAC shall be followed in designing the fuel system for the pumping station.

2. An overhead bridge- type electric crane/hoist will typically be used. The crane/hoist shall be capable of lifting and moving loads up to the heaviest loads in the pumping station. The crane/hoist will handle pumping station equipment such as the diesel engine pump drives, reduction gears, and the pumps during initial installation as well as for general service thereafter.

3. Potable water system and a septic system for the plumbing fixtures.

4. Plumbing facilities to include a toilet with a water closet, a lavatory, and a kitchen-type sink.

5. Ventilation system to provide fresh air in the pump bays, generator area, and toilet room.

6. Air-conditioning system for the office.

7. Stilling wells containing float switches to be used for pump operations and water level monitoring.

8. Trash rake/rack system will be an automatic, continuously rolling, flex rake and trash rack system such as that manufactured by Duperon.

9. An emergency generator to supply power to the electrical equipment at the stations in the event of commercial power outage. This will include

providing power for the lights, controls for the pumps, ventilation fans, trash rake, etc. The emergency generator will not be sized to handle the load for the electric motor pump drives.

10. Controls systems for the engine/motor pump drives. These systems shall be as described in the Electrical Design section below.

11. During the detailed design, the designer shall coordinate with local and state authorities to ensure that the various permits (air, fuel, etc.) are all adequately addressed.

6.4.3.2.3 Pump Intake and Discharge Design

The larger pumps for the medium-sized pumping stations may be designed with Formed Suction Intakes (FSI) and may include siphon discharges. A representative example section of a pumping station with an FSI and a siphon discharge is shown on Appendix A Plate M-7. FSIs have been shown to be more efficient than typical suction bell intakes, but the design decision on whether to use them will be based on comparing potential efficiency savings with increased construction costs over the life of the project.

In order to reduce the engine size and horsepower (and fuel) required to overcome the head on the large pumps, siphoning discharge systems may be used. If a siphon discharge system is used, priming would be accomplished by means of a station vacuum system; however, with the impeller submerged as shown and depending on the characteristics of the equipment offered, the pumping systems should be capable of being self-priming in an emergency. During self-priming, the engine pump drives may be subjected to momentary overload. Again, the design decision on whether to use siphon discharges for the larger pumps in the medium-sized pumping stations will be based on comparing potential savings on the cost of the diesel engine pump drives and the lower fuel requirements with the increased construction costs over the life-cycle of the pumping station. Note that if the siphon discharge is used, each pump discharge tube will be provided with twin vertical-lift type backflow gates, as shown on Appendix A, Plate M-7, with relief flaps located at the siphon terminus. The gates are needed to prevent the possibility of reverse siphoning and backflow due to incomplete breaking of the prime during pump shut-down. Each gate will be raised and lowered by a single screw-stem with a Limitorque-type electric motor operator controlled from within the station.

For discharge pipes that will be below high water levels, a second means of preventing backflow will also be incorporated. The discharge pipes will have their upper invert elevation (summit) above the high water level on the discharge side. The siphon would then self-break.

During design development, the discharge arrangement will be selected based on a life cycle cost analysis of the operational and construction costs.

6.4.3.2.4 Large-Sized Pumping Stations

G-370 and G-372 are already existing large-sized pumping stations located adjacent to the Project. SFWMD constructed G-370 and G-372 within the last five years to provide restoration water for STA-3/4. G-370 is located along the North New River Canal and has three 925 cfs diesel driven pumps, with a design capacity of 2775 cfs. G-372 is located along the Miami Canal and has four 925 cfs diesel driven pumps, with a design capacity of 3700 cfs.

In addition, both G-370 and G-372 have three small 75 cfs electric motor driven pumps included in their design for seepage control, and these six existing 75 cfs pumps will continue to be used for STA-3/4 control seepage. EAA project seepage control requirements will be met with the new medium-sized pumping stations.

Modifications needed in order to use the large pumps of G-370 and G-372 to fill the EAA reservoir are discussed and described below.

6.4.3.2.5 Pumping Station Modifications – General

G-370 and G-372 need to be modified to pump water to fill the EAA reservoir to a maximum water depth of 12 feet, because this is so much more than what these pumping stations were originally designed to do, which is pump water to fill STA-3/4 at a maximum water depth of 5 feet.

The prevailing EAA project area ground level is 10 feet NGVD, while the maximum water level of STA-3/4 is 15 feet NGVD, and maximum pumped level of the EAA reservoir is 22 feet NGVD. In addition, G-370 will need to be able to pump to an elevation of 23 feet NGVD, since its output will flow into discharge impoundment from which gated culverts will direct water to either STA-3/4 or the EAA reservoir.

The amount of pump flow or capacity depends on two basic components: The design of the pump and the amount of power available from the engine. Because flow is a result of the relationship between the available horsepower and the amount of head, as well as the design of the pump and its efficiency, if the pump could still operate at the increased head with the same available horsepower, the flow for each pump would drop. The reduction in flow is also tied into the design of the pump and the impeller, and in order to keep the system on the pump's operational curve, additional horsepower will be required even with a reduction in flow.

6.4.3.2.6 Pumping Station Modification Recommendations

Pump station, pump, and engine design modifications for G-370 and G-372 include the following systems:

a) Pump Station
   - Backflow gates for each large pump
   - Dewatering bulkheads or stoplogs

b) Pump changes
   - New impellers
   - Pump speed increase

c) Diesel engine
   - Speed increase
   - Turbo-charging
   - Auxiliaries (heat exchangers, silencers, etc.)
   - Controls

d) Reduction Gear and power transmission shaft

Pumps at G-370 and G-372 were designed using a discharge chamber as the sole means of backflow prevention, and order to protect against water flowing back from the EAA reservoir through the pumps, both backflow gates and emergency bulkheads must be added to the pump discharge arrangement.

Modification design details are provided below.

6.4.3.2.7 Pumping Station Modification Details

Pump and engine manufacturers have been consulted, and the following modifications are recommended for efficient operation at the increased head requirements and have enough flow to maintain 700 cfs for G-370 and 750 cfs at G-372. Although it may be possible to change the operating system pump curve by using the pump similarity laws and merely increase the pump speed 10% from 113 to 124 RPM, this would result is operating with greater reductions in both flow and efficiency 20% or more less than the normally preferred 80%.

<u>Present Engine Rating</u>:
G-370 - 1360 hp, present rating for 8 cylinder engine, 170 hp per cylinder
G-372 - 1530 hp, present rating for 9 cylinder engine, 170 hp per cylinder

<u>Preliminary Horsepower Rating Required for 12-foot EAA reservoir</u>:
G-370 - 2060 hp rating, when increasing pump speed 10% with the new impeller,
G-372 – 2070 hp rating, keeping the same pump speed and a new impeller.

Engines now operate at 720 RPM, but speed can be increased as high as 900 RPM.

Although horsepower increases with RPM, the maximum normally aspirated design output is 200 hp per cylinder, or 1600 hp at G-370 and 1800 hp at G-372.

Unless horsepower requirements can be reduced by changing the pump discharge design, the only way to have enough horsepower is to turbo-charge the engines at both pumping stations. Turbo-charging this type of engine allows 280 to 350 hp per cylinder to be produced. An engine turbo charging design should be selected so the operational horsepower requirement is at least 50% of the rated output. This means that in cases of low head differential between intake and discharge, the flow might need to be restricted to create head and put enough load on the engine.

Fairbanks-Morse (F-M) engines are capable of operating at 110% of the rated output for a 2 hour overload period. F-M has verified that all F-M engines can satisfy this requirement which is considered an industry standard.

Modified G-370 pump design as proposed by the pump manufacturer, Flowserve, assumes a 10% increase in speed. Either changing the gear ratio or increasing the engine speed could achieve this increase. Coordination with both F-M and Philadelphia Gear will determine which change is more effective. The design of the reduction gears, shafts, and power transmission components need to be checked to see whether capable of handling the increased horsepower and maintaining the recommended safety factor.

Engine modifications will require upgrades and changes in some auxiliaries. The raw cooling water flow can likely be increased using the same pumps and adjusting the orifices. The heat exchangers are believed to be the plate and frame design, and it may be possible to merely extend their area and capacity. The silencers may need to be upsized to handle the higher engine operational level.

6.4.3.2.8 Backflow Prevention Modification Details

The original design of G-370 and G-372 used the control of a discharge chamber as the only means of backflow prevention. However, the maximum EAA reservoir depth of 12 feet makes it necessary to add both backflow control gates and an arrangement for inserting stop logs or dewatering bulkheads. The backflow gate and bulkhead system is needed to provide two means of backflow prevention, a design requirement for cases when the pump discharge is located below the discharge water maximum water level. A means for inserting stop logs downstream of the backflow gates is needed to allow the backflow gates to

be isolated and the discharge area dewatered for access for maintenance and repairs.

Backflow gates will be installed at the discharge tube of each large pump. The gates will be twin vertical-lift roller gates in a bulkhead configuration with relief flaps located at the siphon discharge terminus as shown on Plate M-7. Primary functions of the gates are to protect against backflow during pump shut-down and non-pumping periods when the discharge pool is above the invert (summit), and to prevent possibility of reverse siphoning due to incomplete breaking of prime during shut-down of pumps. Each gate will be raised and lowered by a single screw-stem with a Limitorque-type electric motor operator controlled from within the station.

6.4.3.2.9 Gated Culverts

The gated culverts will use a slide type gate mechanism, which, because of the head requirement, will need to be constructed of stainless steel. If increased water-tightness is desired, resilient rubber seals will be part of the design.

The culvert gate will be a commercially available self-contained stainless steel gate unit similar to those manufactured by Waterman Industries, Inc., and Hydro Gate Corporation. The gate will be designed to meet American Water Works Association leakage requirements for sluice gates. An electric operator will operate the rising stem of design suitable for attaching to a concrete bulkhead. The electric operator will include, but not be limited to, the motor, actuator unit gearing, limit switch gearing, position limit switches, torque switches, stem nut, declutch lever, high precision gate position potentiometer, and hand wheel as a self-contained unit. The actuator will have sufficient capacity to raise or lower the gate at a speed of 6-inch/min against the operating heads. The hand wheel will operate in the clockwise direction to close. External declutch lever will be padlockable in either the manual (hand wheel) or motor mode.

6.4.3.2.10 Generator

Each gated culvert will have an emergency backup generator fueled with liquid petroleum gas (LPG), located in a control room. A generator is required because of the need to assure gated culvert operation during commercial power outages. An underground LPG tank with sufficient capacity to assure operation of the culvert gates for at least 7 days will be used.

6.4.3.3 Electrical Design

6.4.3.3.1 Pump Stations

Electrical service will need to be furnished to the new pump stations. Commercial power is the primary source of power with diesel generators providing backup power as applicable.

The electrical service shall include power distribution, power for the pumps and auxiliary systems, equipment monitoring systems, communications systems and general facilities electrical, such as exterior and interior lighting, receptacles, grounding systems, and water level and other fluids monitoring systems. The electrical systems shall be located in an appropriate enclosure protected from the elements. Coordination with the local power company for the sources of power, new power line routings to the pump stations and any associated costs for building the new power lines shall be conducted as warranted by the design. A 480-volt, three phase, electrical service shall be provided by the local utility company. 480-volt, three phase engine-generator units shall be provided to supply backup electrical power for pumping station operations. Transient Voltage Surge Suppression (TVSS) shall be provided at the service entrance.

6.4.3.3.2 Gated Culverts

A single line diagram is shown on Plate E-6. As a minimum, each structure's electrical system shall contain the following:

The electrical service shall include power distribution, power for the main and auxiliary systems, equipment monitoring systems, communications systems and general facilities electrical, such as exterior and interior lighting, receptacles, grounding systems, and water level and other fluids monitoring systems. The electrical systems shall be located in an appropriate enclosure protected from the elements. A 120/240 volt single phase or 208Y/120 volt, three phase, electrical service shall be provided by the local utility company. A 120/240 volt single phase or 208Y/120 volt, three phase engine-generator units shall be provided to supply necessary electrical power for gate operations. TVSS shall be provided at the service entrance.

6.4.3.3.3 Off-Site SCADA (OS-SCADA)

The OS-SCADA system shall control main and auxiliary equipment, as well as monitor level sensing devices at each facility. The station equipment, controls, and sensing devices at the facility shall provide status and receive control signals from the OS-SCADA system. The remote automation components installed at the pump station and other structures are the remote terminal unit (RTU) (shown on Plate E-7) and communication channel to the SFWMD control

center. The access for the RTU to the control center is via microwave gateway. The automation components of all pump stations and structures that will eventually be operated and maintained by SFWMD and must conform to SFWMD standards in order to (1) achieve cost efficiency in design, construction, operation and maintenance, and, (2) meet safety, reliability, and performance requirements during routine and emergency operations. The automation components are broadly defined to include hardware, software, communications and user interface elements.

6.5 LERRD CONSIDERATIONS

6.5.1 Lands and Interests in Lands and Costs

6.5.1.1 Existing Federal Project

The Miami Canal (L-25, L-24 and L-23) and the North New River Canal (l-20, L-19 and L-18) are all part of the original C&SF Project and lie fully or partially within the lands required for construction, operation, maintenance, repair, replacement and rehabilitation of the Project. All improvements to the Miami Canal will be conducted within the existing right of way owned in fee or perpetual easement by SFWMD. All improvements to the North New River Canal will be conducted within the existing right of way owned in fee or perpetual easement by SFWMD. SFWMD will not receive credit for the provision of these lands or interests in land for the EAA Reservoir Project. The interests owned by SFWMD will be the required estate for these lands.

6.5.1.2 Compartment A

Fee title will be required for the project footprint of the EAA Reservoir, the seepage buffer area, and seepage canals. The EAA Reservoir, the seepage buffer area, and seepage canals require 30,735.48 acres in Compartment A, of which 29,749.18 acres were acquired in the Talisman exchange/acquisition. The remaining 966 acres in Compartment A were acquired by SFWMD. In March 1999, the "Talisman Exchange and Purchase and Sale Agreement" effected transactions pursuant to which the landowners in the EAA would sell lands to, or exchange lands, with other landowners and the SFWMD in order for SFWMD to own contiguous parcels of land in the southern portion of the EAA for the purposes of Everglades restoration. As part of the transaction, SFWMD contributed total payment to buy out the farming reservation held by the St. Joe Paper Company. As per the terms of the Cooperation Agreement between the SFWMD and the DOI, SFWMD elected to apply program income revenue towards the repayment of its contribution. If the program income revenue does not totally satisfy the repayment of SFWMD's contribution, SFWMD will seek credit for the balance of its contribution as an allowable project expense for cost-sharing purposes. The federal funds contributed by DOI pursuant to the Farm

Bill Section 390 of the Federal Agriculture Improvement and Reform Act of 1996 (Public Law 104-127, 110 Stat. 1022) will be credited to the federal share of the project cost pursuant to Section 601 (e)(3) of the Water Resources Development Act of 2000. The state funds contributed by SFWMD for the acquisition of the Talisman property, subject to the paragraph above, and the state funds for the acquisition of the Woerner Property will be credited to the state.

6.5.1.3 Bolles and Cross Canal Rights of Way

The Bolles Canal runs from the Miami Canal east to the North New River Canal. The Cross Canal runs from the North New River Canal east to the Hillsboro Canal. The rights of way for these two canals total approximately 470 acres. These lands were acquired prior to 1955; therefore, the SFWMD will receive its actual acquisition costs. The interests owned by SFWMD will be the required estate for these lands, totaling approximately 470 acres.

6.5.1.4 Stormwater Treatment Area and STA 3/4 Supply Canal

The STA is anticipated to be constructed on lands owned in fee by the SFWMD and State of Florida and the existing supply canal running from the Miami Canal east and south to STA 3/4 will be utilized as a reservoir seepage canal and to supply water to the reservoir. The SFWMD will receive credit for actual acquisition and administrative costs. Fee title will be the required estate for these lands, totaling approximately 2,030 acres. Land required for proposed STA includes an estimated real estate cost of $8,176,000.

6.5.2 Uniform Relocation Assistance Act, PL 91-646

There are no residential relocations entitled to Uniform Relocation Assistance Benefits associated with project implementation. There are no businesses requiring relocation as a result of this Project; therefore, there are no additional persons or businesses entitled to Uniform Relocation Assistance Benefits, Public Law (PL) 91-646, as amended. All relocation benefits were included as part of the Talisman exchange/acquisition agreement.

6.6 OPERATION AND MAINTENANCE CONSIDERATIONS

6.6.1 EAA Operations Maintenance Repair Replacement & Rehabilitation (OMRR&R)

Due to the many differing components of this project, the OMRR&R requirements are varied and complex. They include grass mowing, invasive species control, pump maintenance, structure maintenance, building maintenance, road maintenance, and erosion control. Each of these components

requires a detailed plan and forecast to assure the long-term viability and operability of the project, as constructed.

6.7 PLAN ACCOMPLISHMENTS

The selected alternative plan and preferred plan for purposes of NEPA, would meet all of the project-specific objectives established for the EAA Storage Reservoir. It is expected to provide an aggregated 96,244 average annual habitat units, in comparison to the no-action alternative. It is expected to deliver, on average, 920,000 annual acre-ft of water to the Everglades. Habitat units gained would be in Lake Okeechobee littoral zone, where an average increase in spatial extent is expected, in the St. Lucie and Caloosahatchee estuaries, and in the Water Conservation Areas. Additionally, the Reservoir itself is expected to provide the following local benefits: incidental nutrient removal as a function of water retention and sediment deposition (improving the function of downstream existing stormwater treatment areas; creation of additional shallow seasonal wetlands (wading bird and fish habitat) in the seepage canal littoral zones and seepage buffer areas; and creation of deep water fish refugia in the flooded secondary agricultural canals inside the reservoir. The plan would improve habitat function and quality and it would improve native plant and animal abundance and diversity.

6.8 CONTRIBUTION TO ACHIEVEMENT OF INTERIM GOALS AND TARGETS

To conduct its evaluation, RECOVER first considered the LAI modeling runs for each alternative plan to ensure that each alternative was still consistent with system formulation. The results of this screening confirmed that no alternative plan performed significantly better or worse when considering all other CERP projects in the simulation. The next step in RECOVER's evaluation was to consider the NAI to determine if differences occurred among alternative plan performance. Review of RECOVER's system-wide performance measures as well as additional relevant information mentioned in the report indicates that the Project meets its goals of: (1) improving habitat in Lake Okeechobee and the estuaries by reducing EAA irrigation demands on Lake Okeechobee and providing storage of regulatory releases from Lake Okeechobee, (2) improving habitat in the EPA by providing adequate timing of environmental water deliveries and providing storage of regulatory releases from Lake Okeechobee, and, (3) increasing flood protection within the EAA.

The project has a positive effect upon the lake's littoral zone wetlands reducing the number of high stages (greater than 15 feet for 365 days or more). Operating at lower stages will help maintain the nutrient budget of the lake. EAA backpumping to the lake as well as STA bypasses both declines under the future with project (next added increment).

For the Caloosahatchee Estuary, the NAI alternative plans are slightly better than the future without project. During the dry season, the NAI alternative plans show increased number of months with flows less than 300 cfs with no substantial differences between the alternatives. This increase would negatively affect the salinity conditions within the estuary. For the St. Lucie Estuary, the NAI alternative plans are slightly better than the future without project. The 14-day moving-average of flows greater than 2000 cfs, including lake releases, is better for the NAI alternative plans than the future without project. For Lake Worth Lagoon there were no significant differences between the future without project and the NAI alternative plans.

Larger Lake Okeechobee regulatory releases to the south benefit the system by reducing adverse impacts to estuaries and lowering seasonally high stages in the lake. Fewer water supply releases from Lake Okeechobee for EAA irrigation are considered a benefit, leaving more water in the lake for the natural system. Water supply to the EAA from Lake Okeechobee under the NAI is less than half that of the future without project condition. Significant increases in evapotranspiration result in a reduction in total water available in the regional system. However, total losses from evapotranspiration under the next added increment are much lower than the total losses to tide under the future without project condition and direct rainfall into the reservoir also offsets evapotranspiration losses.

In the Greater Everglades, there are no significant differences between the four NAI alternative plans, or between the NAI alternative plans and the future without project condition when the full 36-year POR is averaged; however, RECOVER did note some small differences, suggesting that significant differences might be observed if only the wettest and driest years were examined. There were consistent small differences between the four NAI alternative plans and the future without project condition in the marl marsh indicator regions. Similarly, there was a small difference between the four NAI alternative plans and the future without project for GE-E1, suggesting that the project may provide some benefit in terms of fewer dryouts in Shark River Slough.

The EAA storage reservoir provides water quality treatment benefits both within reservoir as well as down stream in the STAs. The reservoir itself provides additional retention time increases, the settling rate of particulate matter lowering water column TP along the flow path of the STA, and maintaining TP loads further away from the GE. Additional storage capacity in the reservoir will aid in keeping STAs saturated during the dry season, potentially lowering the level of nutrient flux from sediments. Lowering the volume delivered to the STAs lowers the probability that STAs will be loaded

beyond their design capacity. RECOVER also recently received two DRAFT water quality reports and will provide further comments as needed. This information was only recently provided to RECOVER (7-26-05 and 7-28-05). RECOVER reviewed the Draft Water Quality Reports (Wetland Solutions, Inc. 2004 and Water and Air Research, Inc. 2005) and most RECOVER comments were consistent with the reports. The key factors recognized by the reports and RECOVER are the importance to maintain water in the reservoir when possible, optimize hydraulic residence time, provide steady flows to the STAs, and maintain hydrated soils in the STAs.

The RECOVER evaluation team recognizes that additional modeling runs have not yet been run by the IMC. RECOVER expects to review this additional output and will provide additional comments where necessary. In addition to the system wide evaluation of the Project, RECOVER also evaluated the quantification of ecological benefits methodology. This review will be submitted as a separate report. Annex E contains the modeling results used by the RECOVER ET review team.

6.9 SUMMARY OF ECONOMIC, ENVIRONMENTAL, & OTHER SOCIAL EFFECTS

The primary economic effects of the project are the costs of implementation, and the ecosystem restoration and improvement effects. The project cost (NED cost) represents the largest monetarily expressed impact of plan implementation. Project costs have regional impact dimensions as well, as expenditures on the project can cause changes in local and regional earnings, sales, and employment, due to the ripple effect of project spending throughout the regional economy. The most significant beneficial effect of the project is the ecosystem improvement expected to result from the plan.

The EAA Storage Reservoir features will provide important storage functions essential to the overall restoration of the freshwater marshes and the estuaries and the downstream Everglades. The project will permanently remove thousands of acres of land from agricultural production. These impacts may be felt locally and/or regionally as the economic base derived from agriculture is incrementally reduced relative to other sectors of the economy. The overall benefit to the regional system is expected to be far greater than the localized adverse effects. The project will benefit South Florida ecosystems. Specifically, it will benefit the St. Lucie and Caloosahatchee Estuaries and Lake Okeechobee as well as improve the quality and timing of water delivery to the STAs for improved water treatment within the STAs. Benefits to the Caloosahatchee and St. Lucie Estuaries will result from reducing the extreme discharges to the estuaries. Ecological benefits from this project include:

- Salinities in the riverine portions of the Caloosahatchee River will increase to allow oyster reef growth;
- Expansion of 18 acres of oyster beds in the Caloosahatchee Estuary to 100 acres in the next 10 to 15 years;
- Increase the spatial extent and improve the function of submerged aquatic vegetation the Caloosahatchee River and Estuary;
- Salinities in the St. Lucie Estuary will be between 350 to 2,000 cfs to allow oyster reef growth;
- Expansion of oyster beds in the St. Lucie Estuary to approximately 890 acres of oysters;
- Increase the spatial extent and improve the function of submerged aquatic vegetation the St. Lucie Estuary; and,
- Increase the health of fish in the St. Lucie and Caloosahatchee Estuaries by reducing prolonged discharges of large volumes of lake water. Rather than relying on Lake Okeechobee to provide water storage, use of the proposed EAA reservoirs with other CERP reservoirs and ASR for water storage will have beneficial effects to the health and ecology of the lake.
- Reduction of extreme high and low levels in Lake Okeechobee, resulting in:
  - Increase in the amount and quality of submergent and emergent plant communities in Lake Okeechobee; and,
  - Improve foraging and habitat for wading birds and native fish. Some improvement to lake water quality will occur as a result of the Project by redirecting nutrient rich EAA drainage to the reservoirs rather that directly to Lake Okeechobee.

Improvements to the water quality entering the WCAs will result from the ability to more effectively store water within the proposed EAA reservoirs by metering peak flows in the STAs. STAs are intended to provide treatment rather than store water; however, during the wet season and flood events, they have been used to provide both functions. Creation of the reservoirs will provide the needed storage function, allowing the STAs primary use as water treatment facilities. Increased residence times of water within the STAs will ensure better treatment of waters released to the WCAs and have beneficial water quality effects on all downstream ecosystems.

The selected alternative plan would affect 3 farm parcels covering about 33,135 acres, would displace a maximum of 20 resident non-owners. It would not impact any known historic or cultural resources. There would be no adverse impacts on minority or disadvantaged populations. Permanent habitat losses due to land conversion to deep water and structures within the footprint would be offset by the gain in habitat quality in Lake Okeechobee, the northern estuaries and the WCAs.

SECTION 7
ENVIRONMENTAL EFFECTS OF THE SELECTED PLAN

This page intentionally left blank

7.0 ENVIRONMENTAL EFFECTS OF THE SELECTED PLAN

This section documents the environmental impacts and benefits of the selected plan (the preferred alternative). It presents detailed analysis on the environmental effects including unavoidable adverse effects, irreversible and irretrievable commitments of resources, cumulative effects, and environmental commitments. Documentation also is provided for a comprehensive review of water resources issues, including water supply, flood protection, threatened and endangered species, and other natural system and habitat needs. In addition, this section provides recommendations to minimize the potential impacts identified for the preferred alternative.

7.1 GEOLOGY, TOPOGRAPHY, AND SOILS

7.1.1 Geology

Some caprock would be removed on site for use as construction material for embankments. Most of this limestone caprock would be obtained from widening of canals and during excavation of deep water refugia within the reservoir. The underlying regional geology would not be affected.

7.1.2 Topography

The plan includes conversion of relatively flat, uniform agricultural lands to a reservoir with deep water and embankments up to 23 feet above existing grade (generally 12 ft NGVD). The seepage buffer on the east, west, and north of the project site would have a 100 foot wide strip returned to existing grade, with the remainder of the buffer contoured as an upland and wetland mosaic of appropriate topography. Contouring of the STA component and canal littoral shelves would lower existing topography to mimic suitable depths for long-hydroperiod wetlands. These topographic changes, along with operations of the reservoir, would significantly alter the current surface hydrology of the property.

7.1.3 Soils

Soils in the construction footprint will be redistributed by construction activities and excavation for embankment materials. Soils that remain undisturbed within the reservoir footprint would be impacted during operations of the reservoir, as a layer of fine sediments containing a high level of organic debris and nutrients will settle from the overlying water to coat the bottom. The low oxygen environment that is expected at the bottom of the reservoir will act to preserve organic material in the remaining soils and in the sediment.

Soils within the canals will also be removed during widening. Littoral shelves constructed within the seepage canals would experience sediment deposition as

sediment and plant material settle post-construction and produce peat/mucky soils over time. Soils within the buffer area and STA are anticipated to remain hydric and retain muck properties or revert to muck properties post-construction.

The soils on the project site are classified as Unique Farmland by the NRCS. Coordination was completed with USDA/NRCS and a determination was made that 31,473 acres of Unique Farmland would irretrievably be lost through conversion of the project site to an open water reservoir. This represents approximately 8% of farmland in the county of this quality to be converted. Refer to the Pertinent Correspondence Annex H, correspondence with NRCS for details.

The project may benefit soils regionally, as better water management practices may reduce the rate of soil subsidence in areas surrounding the reservoir. This proposed reservoir, in combination with other CERP water storage elements, is expected to ultimately improve hydroperiods in the Water Conservation Areas and reduce subsidence of soils there. Overall, significant impacts to soils are anticipated to be minor and localized. Some beneficial impacts are associated with implementation of the proposed project. However, the conversion of prime farmland is anticipated to be significant and irretrievable.

7.2 HYDROLOGY

Construction and operation of the proposed reservoir, canals and STA would permanently affect surface hydrology. At present and under the no-action alternative, water flows are/would be controlled by agricultural water management practices. Post construction water will be pumped into the surface reservoir and contained within the reservoir, the STA or the adjacent canals. Some of the impounded water would seep under cut-off walls surrounding the impoundment and re-emerge within the seepage buffer or seepage canal collection system. The exception is within the southwest corner of the project site. The areas that are anticipated to be affected are the Holey Land WMA and Rotenberger WMA. Modflow modeling indicates that at extreme conditions (water impounded at 12 feet within the reservoir), ground water stages could increase by up to +1.0 feet, with stages lowering into a southward direction, away from the reservoir. The associated affects on the water stages within these WMAs is currently under investigation and will be updated in the final PIR.

The groundwater aquifers may be impacted by the proposed action. The reservoir would act to recharge the surficial aquifer. The reservoir water would be in direct contact with the surficial aquifer through the surface soils. The surficial aquifer will be recharged by the reservoir and it is expected to show higher post-construction levels over the EAA region.

7.3 FLOOD PROTECTION LEVEL OF SERVICE

7.3.1 Flood Protection Level of Service

The original drainage design for the EAA was nominally based on a rainfall event with a return frequency of 10 years. The capacity of the primary pump stations serving the Miami, North New River, Hillsborough and West Palm Beach Canals is 20,645 cfs. The service area has decreased from approximately 591,755 acres to about 499,800 acres as a result of removing the Rotenberger and Holey Land WMAs, as well as construction of STAs. Pump stations G-370 and G-372, replacing the roles of S-7 and S-8 in draining the EAA, also act to increase the total drainage pump capacity.

Flood protection in the EAA would be improved by ensuring the major canals are adequate to take advantage of the increased drainage rate resulting from improvements in the EAA. Increasing the capacity of the Bolles and Cross Canals will improve flood protection during localized rain events by allowing more efficient movement of water between the Miami, North New River, Hillsboro, and West Palm Beach Canal basins. The rate of inflow into the STAs will continue to be limited by the capacity of the inflow pump stations and internal control structures.

As an additional benefit, canal improvements will increase the storage capacity within the canals themselves. Increasing the width of the Miami, North New River, Bolles, and Cross Canals' conveyance will create additional storage. This will help attenuate flows at the beginning of storm events.

The proposed storage reservoir, canal improvements, and STA would add to the storage capacity for area flood waters. The system also would introduce additional flexibility in developing plans for extreme events such as a hurricane. Thus, there is a beneficial impact of the proposed action upon flood protection level of service.

7.4 CLIMATE

The proposed action is not expected to significantly impact the general climate of the EAA. There may be some minor impacts on local microclimates as a result of the presence of a large body of water or the dikes containing the reservoir. This will take the form of altered wind directions, slightly moderated temperatures, and an increased likelihood of fog formation. The proposed action may significantly lessen the impact of stormwater from hurricanes and other storms. The reservoir may be used to help control floodwaters and related environmental damage. Replacement of crops with open water will act to increase evapotranspiration, which may have a minor, very local effect.

7.5 AIR QUALITY

The operation of heavy equipment used for construction of the reservoir and supporting facilities and the operation of pumps and other equipment associated with the proposed action may have some impact upon the local air quality, primarily in the form of elevated particulates, nitrogen oxides, and volatile organic compounds. Reservoir pumps and associated equipment would be powered by diesel engines or additional electrical power with appropriate backup generators.

The area is rural and the existing air quality is good to moderate. The additional loading of engine gases should not substantially impact the quality of the air in the region.

Every Federally funded project must be consistent with state plans for implementing the provisions of the Clean Air Act Amendments (State Implementation Plans). This project is in conformance with the State Implementation Plan because it would not cause violations of the National Ambient Air Quality Standards.

7.6 NOISE

The construction of the proposed reservoir and attendant structures will result in a temporary increase in sound levels in the vicinity of active construction. The operation of the pumps associated with the storage reservoir will increase sound levels in their vicinity. Use of emergency generators will further elevate the sound levels. The absence of a significant population minimizes the impacts of these increases in sound levels. No significant impacts to wildlife have been observed in the vicinity of other similar pump stations in the general area. Minor impacts to noise quality are anticipated.

7.7 VEGETATION AND COVER TYPES

Most existing plant cover within the approximately 35,500 acre footprint for the proposed alternative would be removed by the reservoir, canal and STA construction. In general, construction will largely displace existing vegetation communities with aquatic habitat (water-covered reservoir areas) or maintained uplands (embankments, roads, berms). The majority of the land will be water-covered to a depth of 12 feet. The reservoir will most closely resemble an open-water lake community with significant differences. The reservoir will lack much of a highly productive littoral zone because of the necessity to construct relatively steep sides to maximize water storage capacity. Side slopes of the earthen embankments are planned at a 3 to 1 ratio with riprap along the inside slopes.

However, the proposed project's footprint currently is dominated by the disturbed agricultural land and associated features (roads, staging areas). According to an interagency wetland assessment of the site, including the area proposed for the STA placement, 206 acres of functional wetland habitat would be removed by the project construction (USFWS, 2003).

A 200-foot buffer area is proposed for creation along the east, north, and western boundaries of the reservoir. This seepage buffer will extend 200 feet from the base of the embankment. It will provide both seepage control and wildlife habitat within the project footprint, encompassing a total of 560 acres. The design of the buffer is to mimic an upland-wetland mosaic and allow for maintenance of the reservoir embankment. The first 50 feet of the buffer will be an upland maintenance corridor. From 50 to 100 feet, the buffer area would be regarded post-construction to the existing grade and allowed to re-vegetate naturally as a wetland. From 100 to 200 feet, the buffer area would contain a deeper (-2 feet elevation from existing) excavated wetland interspersed with tree islands sloped to 4 feet above existing grade. Tree islands will be approximately 50 feet wide, and occupy approximately 75% of the total length of linear feet of buffer area. Therefore, approximately 95 acres of tree island habitat will be provided within the buffer. Wetlands created and restored in the buffer footprint will be approximately 404 acres of wetland habitat. The wetland portions would be hydrated by rainfall, seepage from the reservoir, and perhaps groundwater "backed up" from the cut-off walls. The elevated tree islands will be planted with native tree vegetation of appropriate species.

In addition, a littoral shelf would be constructed within the seepage canal surrounding the seepage buffer and project site. The littoral zone will be located along the length of the seepage canal for approximately 110,000 feet. The shelf would be approximately 30 feet wide. The first 15 foot wide section would be contoured to a 1V:5H slope. The second 15 foot wide section would be contoured to a 1V:2H slope. The littoral shelves would be constructed by scraping the peat layer adjacent to the canals. The shelf should provide an estimated 76 acres of habitat for fish and wildlife, especially wading birds.

The STA component would convert approximately 1,495 acres of agricultural land to a shallow, long-hydroperiod, vegetated wetland for the purposes of removal of nutrients. This will add wetland functionality, but may not be suitable for wildlife habitat.

A significant EAA study objective is to reduce lowering of Lake Okeechobee for EAA irrigation withdrawals during the dry season and reduce discharges of storm water by back-pumping into the Lake during the rainy season. The overall potential effect is a reduction in extreme lake levels, both high and low;

and a reduction in adverse high water stage discharges to the estuaries. In addition to benefiting the estuaries, removal of the most extreme high and low water stages should allow some recovery of the currently stressed Lake littoral zone.

7.8 FISH AND WILDLIFE

7.8.1 Aquatic Fauna

Small areas of existing open water habitat would be lost under the construction footprint. Once the reservoir is constructed, aquatic (open water) habitat will substantially increase. The open water reservoir will likely harbor fish typical of nearby canals. Water would be conveyed to the reservoirs by these canals which also act as conduits for the introduction of many aquatic organisms, including fish. Species that will likely inhabit the reservoirs include: largemouth bass, black crappie, redear sunfish, shad, bluegill, and mosquitofish, among others. Diversity of invertebrates living in reservoirs can be low, especially in deepwater systems that lack emergent vegetation. Invertebrates typically found in lake sediments that provide forage for fish include chironomids, crayfish, and shrimp. In general, shallow water fish bedding and rearing habitat will be limited to the margins of the reservoir. The reservoir's limited littoral zone may tend to reduce populations of fish species dependent upon this habitat for reproduction and sheltering juveniles.

Amphibians and aquatic reptiles including frogs, turtles, snakes, and alligators will likely inhabit the deepwater reservoir. Limited emergent vegetation in the reservoir will also affect these organisms by reducing available forage, cover, and reproductive habitat. The reservoir will also create foraging habitat for osprey, bald eagle, terns, cormorant, and other aquatic birds that feed on fish. Ducks may also use the reservoir, but low cover of submergent and emergent vegetation may limit the habitat value. Mammals in the reservoir will likely be limited to river otter.

A littoral zone will be constructed between the reservoir embankment and the seepage canal outside of the reservoir. The STA would be constructed adjacent to the south-western portion of the reservoir between the reservoir and the Miami Canal. The littoral zone and STA would provide habitat for invertebrates, fish, and amphibians.

7.8.2 Wetland Fauna

At least 206 acres of functional existing wetlands will be displaced by the reservoir footprint. Actual habitat loss for wading birds likely will exceed the 206 acres of identified wetlands, as flooded sugarcane fields provide seasonal foraging habitat for a variety of wading and shorebirds. Wildlife observed using

herbaceous and shrub wetlands include marsh rabbit, red-winged blackbird, roseate spoonbill, anhinga, great egret, green-backed heron, belted kingfisher, little blue heron, tri-colored heron, and common moorhen, among others. These species are expected to occur in the seepage buffer, littoral zone, and STA constructed outside the reservoir.

Within the reservoir, some emergent wetlands may develop along a narrow shelf on the margins of each reservoir cell. Vegetation along the shelf will likely be dominated by herbaceous cover with occasional areas of shrubs. Woody species will likely be managed to maintain low stature along the upland embankments. Many of the species observed in the existing wetlands will use littoral zone wetlands in the reservoir.

Creation of wetlands within seepage buffers is proposed as part of the preferred alternative. These seepage buffers would be located within the reservoir footprint, exterior to the reservoir embankment. Under the preferred alternative, approximately 404 acres of valuable wetland habitat would be created within the footprint. The STA would add approximately 1,495 acres of functional wetlands to be utilized by wildlife. The seepage buffer would help to reduce adverse water quality effects of seepage water. The STA would further filter any discharged water routed to natural areas downstream of the project site. Both the seepage buffer and the STA are anticipated to provide habitat for macroinvertebrates, amphibians, reptiles, wading and aquatic birds, and small mammals.

The seepage buffer will contain upland "islands" between the wetland area and the littoral zone. This wetland/upland mosaic will provide habitats for a variety of species that require both these habitat types to survive.

7.8.3 Upland Fauna

No existing natural upland communities will be displaced by the proposed reservoir footprint, although some agricultural areas may provide terrestrial "upland-like" habitat for some species.

Construction of both reservoir cells would create a system of interconnected upland embankments separating the reservoir cells. These embankments will allow for flexible water management. The upland embankments will not technically be upland communities within the land cover classification, but they will partially function as an upland habitat. They would provide some upland habitat as resting, basking, and burrowing places for birds and reptiles; provide corridors for non-aquatic species and nesting habitat for aquatic turtles, ground-nesting birds, snakes and possibly alligators. The presence of the embankments will help to improve wildlife and plant diversity in an area to be

dominated by aquatic habitat. Use of the embankments by vehicles may make resident and transient wildlife somewhat more vulnerable to road kill since upland habitat will be scarce in the vicinity of the reservoir.

7.8.4 Fauna of Disturbed Areas

Approximately 33,500 acres of disturbed agricultural habitat would be replaced by the construction of the preferred alternative. These habitats represent the most extensive landscape feature throughout the region. Although they historically replaced native wetland communities, they still provide some wildlife benefits, providing feeding areas, cover, or breeding/nesting habitat for generalist wildlife species that can use a broad range of environmental conditions such as boat-tailed grackle, cattle egret, common nighthawk, killdeer, turkey vulture, and treefrogs. A few more specialized species such as burrowing owl or woodstork may also use these lands where the habitats marginally meet certain environmental needs. Flooded sugarcane fields provide seasonal foraging habitat to a variety of wading and shorebirds.

Conversion of agricultural land to an open water reservoir would reduce the potential habitat for terrestrial wildlife. The USFWS has noted that although there would be an overall loss of habitat for terrestrial and shallow water species with the conversion of agricultural lands and associated canals, this may be beneficial overall, as prey on agricultural lands "may be potentially hazardous to wading birds" (USFWS 2005)

Temporary adverse effects on wildlife are anticipated during construction due to noise, land grading, and lighting. Commitments to the protection of wildlife during the construction phase are documented in the Environmental Commitments section of the PIR. Wildlife is anticipated to return to the area after construction. Overall wildlife habitat benefits are expected to occur in the littoral zone of Lake Okeechobee, the St. Lucie and Caloosahatchee estuaries, and natural areas downstream. Reducing Lake Okeechobee high water events should increase appropriate nesting and foraging habitat for wading birds and habitat for fish and invertebrate reproduction. In addition, the reduction of pulsed releases to the St. Lucie and Caloosahatchee Estuaries during the wet season should benefit fish and wildlife resources in these regions. Overall, the project is anticipated to significantly benefit fish and wildlife resources.

7.9 ENDANGERED, TREATENED, AND STATE LISTED SPECIES

According to terms of an agreement between the USACE, USFWS, and NOAA, this Draft PIR/EIS also acts as the Biological Assessment for the purpose of Section 7 consultation under the Endangered Species Act. Table 2-6 is a list of endangered, threatened, and species of special concern known in the EAA vicinity or other affected areas. However, this table does not provide an overall

indication of use by protected species since many listed species can use Disturbed (agricultural) or Urban and Extractive habitats.

7.9.1 Florida Panther

The Florida panther may be adversely affected by the proposed placement or construction of the reservoir and STA. While the proposed project site is located outside the primary and secondary zone for the panther, it may utilize cover types that occur in the project footprint. In addition, the proposed site is within the panther dispersal zone and historic panther home range. The panther secondary zone is adjacent to the site, and telemetry data indicates that panthers have used adjacent areas, especially along the Miami canal. Once construction of the reservoir is complete, panthers may be forced to travel greater distances to cross or skirt portions of the EAA. There may be a loss of potential ranging, resting, and foraging habitat for the panther as a result of converting wetland, agricultural, and terrestrial areas in Compartment A to an aquatic system. The seepage/habitat buffer, reservoir embankment, and STA may partially compensate for the loss of ranging lands and potential habitat for the panther within the project footprint. It is also anticipated that the project would improve panther habitat within the WCAs with long term operation. The USACE has determined that the project "may adversely affect" the panther. A biological assessment on the panther is being prepared and will be coordinated with the USFWS.

7.9.2 West Indian Manatee

As discussed in Section 2, manatees are currently able to access canals within the EAA, including those associated with the project site and the canals slated for expansion. Manatees have been documented in the area and have even gained access into the STA 3/4 water control structures adjacent to Compartment A. Manatee concerns relating to the footprint of the EAA Project are mainly due to the operation of structures including pump stations and spillway culverts.

As the manatees currently have access to canals within the EAA, there exists the possibility for harm and/or mortality of manatees as a result of construction activities associated with canal expansion, including blasting, dredging, and watercraft activities.

Cumulative adverse impacts to the manatee could result from construction of the Miami, North New River, Bolles, and Cross Canals as well as numerous agricultural canals and from concurrent or future projects in the EAA. Construction of the canals has allowed the manatee to enter a region that it did not historically access; this, combined with the unsuitable habitat of the canals, increases the risk of manatee mortality (USFWS, 2005). Other projects that are

concurrent with this project include the Everglades Construction Project, in particular, the proposed expansion of STAs 2 and 5. These projects, like the Selected Plan, will have various pump stations and other structures that may pose a risk to the manatee.

In order to protect the manatee and reduce the risk of adverse impact, the Corps will implement the following conservation measures:

The USFWS's Standard protection measures for the Florida Manatee will be used during all construction-related activities where appropriate, including observer protocols upstream and downstream of turbid conditions to ensure manatees are not in the vicinity during construction.

The Manatee Blasting Protocol will be used when explosives are required, including having ground and boat observers, and turbidity curtains or other temporary barrier to keep manatees out of the danger zone of the canal.

Intake canals and structures for the proposed project would include an aluminum grate extending from the bottom of the structure to approximately one foot above high water, with 8- inch bar spacing. The grates can be designed for temporary removal in the event of a water emergency. The Interagency Manatee Task Force has recommended that barriers be placed at the Lake Okeechobee structures (S-351, 352, and 354) to prevent manatees from entering the EAA. If barriers are in place prior to construction of the EAA Project, adverse effects to manatees in the EAA will be minimized, and observer protocols and barriers at individual structures of the EAA Project will be unnecessary. The manatee barriers would be in place prior to any operational testing of pumps associated with the proposed project.

With these conservation measures in place, the USACE determines that the Selected Plan "may affect, but is not likely to adversely affect" the manatee.

7.9.3 Wood Stork

Wood storks typically forage in a variety of wetlands throughout the state, often far from known rookeries. However, during breeding season, productive wetlands providing good forage near rookeries are important to reproductive success. Seasonally flooded agricultural fields are also wood stork foraging habitat (Pearlstine et al. 2004). Loss of foraging habitat will occur in the project footprint as a result of reservoir construction, both from elimination of at least 206 acres of functional wetlands and the loss of seasonally flooded agricultural fields. As embankments will be steep and covered with riprap/rock along the interior face of the reservoir, the embankments will likely provide limited resting/foraging areas for wood storks. Of greater importance to wood storks is

the shallow habitat that may be created during the dry (breeding) season in the main portion of the reservoir, since wood storks require shrinking wetlands to concentrate food resources for their specialized feeding. Listed wading birds (including wood storks) and other wetland dependent fauna will also benefit from the deep-water refugia created within the reservoirs. These refugia may become important foraging areas for listed wading birds during extreme drought. This will possibly create opportunities for wading bird foraging. Also, the short-hydroperiod wetlands within the 560-acre seepage/habitat buffer, the long-hydroperiod wetlands within the approximately 1,495 acre STA, and the 76 acres of contoured littoral shelves along the seepage canal may provide suitable habitat for wood stork foraging and compensate for some of the loss of existing wetlands and temporarily flooded fields. Wood storks have been documented foraging along the margins of canals. Foraging opportunities along the Miami, North New River, Cross, and Bolles Canals may be temporarily disrupted during canal expansion activities. However, no long-term effects are expected.

Although drydowns within the reservoir could concentrate and improve prey availability for wood storks, the potential remobilization of contaminants is of concern. When aquatic areas such as a reservoir dry and are subsequently rehydrated, there is the potential for harmful contaminants such as mercury to be remobilized and ingested by prey species or by wood storks directly while feeding, thus negatively impacting the stork. The operation of the reservoir will be such that complete drydown of the reservoir cells will be minimized. The USFWS and FFWCC will be involved in developing the operations manual. The Habitat Guidelines for the Woodstork in the Southeast Region will be incorporated into the construction specifications. The USACE determines that this project “may affect, but is not likely to adversely affect” the wood stork.

7.9.4 Bald Eagle

Bald eagles use the EAA and open water for occasional foraging; however, no eagle nests are documented in the vicinity of the project site. Eagles prefer using available open water areas near Lake Okeechobee for both nesting and foraging. Replacement of agricultural lands by open water reservoirs should not adversely affect bald eagle populations and may improve open water foraging areas. However, as discussed above regarding wood storks, when aquatic areas such as a reservoir dry and are subsequently rehydrated, there is the potential for harmful contaminants such as mercury to be remobilized and ingested by prey species of the bald eagle, thus negatively impacting the eagle. Reservoir drydowns will be minimized to the extent practicable. Also, the Management Guidelines for the Bald Eagle in the Southeast Region and Bald Eagle Standard Local Operating Procedures for Endangered Species will be used during construction of the EAA Project. If new electrical lines are constructed near open water to service new pumps, the publication "Suggested Practices for

Raptor Protection on Power lines: The State of the Art in 1996" shall be consulted for recommended measures to protect bald eagles from electrocution. The USACE determines that this project "may affect, but is not likely to adversely affect" the bald eagle.

7.9.5 Audubon's Crested Caracara

Audubon's crested caracara is a widely foraging species using agricultural lands. Juveniles are nomadic, foraging sporadically over much of the agricultural lands in the EAA. Since the project footprint is outside their core breeding and nesting areas, it is unlikely that loss of foraging habitat will adversely affect this species. If caracaras or nests are encountered on the site, the USFWS will be consulted to ensure caracaras are not affected by the proposed activities. The USACE determines there will be "no effect" on the caracara.

7.9.6 Everglade Snail Kite

Although conditions may be suitable for apple snail populations in some isolated wetlands, canals, and ditches in Compartment A, no apple snails were observed during ground surveys and it is doubtful that these areas could support viable long-term apple snail populations. In addition, due to fluctuations in water levels and absence of vegetation, it is unlikely that apple snails would establish populations inside the EAA Project reservoir and along the embankment system once construction is complete. Therefore, significant foraging habitat impacts for snail kites are not expected in Compartment A or the reservoir as a result of the EAA Project Selected Plan. Due to the expected short-hydroperiod of the wetland portion of the seepage/habitat buffer and littoral shelves along the seepage canal, conditions suitable to apple snail reproduction and snail kite foraging are possible, but unlikely.

This project may impact water stage conditions in WCA 2 and 3. The initial operating plan has been designed to minimize increases in high stage events and low stage withdrawals. In addition, littoral zones around Lake Okeechobee should significantly benefit from reduction in high stage events. This should benefit the conditions for apple snail populations and subsequently snail kites in the Lake Okeechobee littoral zone. The initial operations plan would be in place until other CERP features are functional and can receive the additional water that can be made available by the EAA Storage Reservoir. With all CERP projects functioning, the long-term operational plan of EAA should improve habitat for apple snails. Therefore foraging habitat for snail kites should improve with this project. The USACE determines that this project "may affect, but is not likely to adversely affect" the snail kite or its critical habitat.

7.9.7 Eastern Indigo Snake

Eastern indigo snakes were not documented in Compartment A, although available habitat is present but marginal. They are a wide-ranging species capable of utilizing a variety of habitats; therefore, they could occur within the affected area. Construction of the 31,000-acre reservoir on primarily agricultural land will result in the removal of potential habitat for the indigo snake. However, as the exterior embankments will be covered with soil and grass, they are expected to provide potential habitat for the snake. Also, the 50-foot wide upland portion of the seepage/habitat buffer may provide some improved habitat over that currently found within the buffer footprint. The use of the maintenance roads may make wildlife using these areas more vulnerable to road kill. There exists the possibility of mortality of individual indigo snakes during construction and upon initial flooding of the reservoirs. The Standard Protection Measures for the Eastern Indigo Snake (USFWS, 2002) will be followed during construction. The initial flooding of the reservoir would be at a rate of one half inch per day until a depth of six inches is attained in order to minimize negative impacts to the Eastern indigo snake. The USACE determines that the project "may affect, but is not likely to adversely affect" the indigo snake.

7.9.8 American Alligator

The American alligator is a common species in the EAA occurring in open water habitat and wetlands. The alligator was documented in wetlands and canals in Compartment A. Although alligators will be affected by reservoir construction and canal expansion, they are a mobile species capable of retreating to unaffected areas. No alligator populations will be significantly or permanently affected. Once construction is completed, open water habitat will be greatly increased, expanding use by alligators. Embankments will likely create some suitable nest substrate for alligators. There will be "no effect" on the alligator.

7.9.9 Sea Turtles

One of the objectives of this project is to reduce Lake Okeechobee regulatory releases to the St. Lucie and Caloosahatchee Estuaries, and thereby improve the water quality and salinity regime of the estuaries. This project, in concert with other CERP projects, is expected to improve estuarine habitat conditions, including benefiting oyster bars and increasing the spatial extent of submerged aquatic vegetation. Improving the overall health of the estuary will benefit sub-adult sea turtles in the water that may forage in estuarine areas by increasing their food sources. For the aquatic environment, the USACE determines this project "may affect, but is not likely to adversely affect" the sea turtles. As this project will not affect the beaches, the USACE makes a determination of "no effect" on the nesting habitat of sea turtles.

7.9.10 Smalltooth Sawfish

As stated above, this and other CERP projects are expected to improve estuarine conditions. A more stable salinity regime should result in increased submerged aquatic vegetation coverage and increased populations of small fish and benthic organisms, which are a food source for the sawfish. As such, the USACE determines this project "may affect, but is not likely to adversely affect" the sawfish.

7.9.11 Opossum Pipefish

Besides improving estuarine conditions, this project is expected to improve the littoral zone of Lake Okeechobee. Opossum pipefish have been documented in the St. Lucie Canal and the lake, and require dense emergent vegetation for breeding. This and other CERP projects are expected to improve water stages in Lake Okeechobee, which would result in benefits to the littoral zone, and reduce the amount of backpumping of agricultural runoff to the lake. These benefits to the water quality and vegetation of the lake would increase the food source and breeding area for the opossum pipefish. The USACE determines this project "may affect, but is not likely to adversely affect" the opossum pipefish.

7.9.12 Okeechobee Gourd

The current survival of the Okeechobee gourd is threatened by Lake Okeechobee water regulation practices and the expansion of exotic vegetation (primarily Melaleuca) (USFWS, 1999). This project is expected to improve water stages in the lake, which may help to reduce the extent of exotic vegetation. The effects of this project on the Okeechobee gourd, if any, are expected to be beneficial. The USACE determines this project "may affect, but is not likely to adversely affect" the Okeechobee gourd.

7.9.13 Johnson's Seagrass

One of the objectives of this project is to reduce Lake Okeechobee regulatory releases to the St. Lucie Estuary, and thereby improve the water quality and salinity regime of the area. This project, in concert with other CERP projects, is expected to improve estuarine habitat conditions, including benefiting oyster bars and increasing the spatial extent of seagrasses. Current modeling results from the South Florida Water Management Model (SFWMM) indicate a reduction in regulatory releases by approximately 25 percent. The estuary is likely to have more stable salinity concentrations, and the reduction of releases from the lake is expected to also reduce the concentration of nutrients and pesticides going into the estuary. This project is expected to have a beneficial

effect on Johnson's seagrass. The USACE determines this project "may affect, but is not likely to adversely affect" Johnson's seagrass.

7.9.14 State-listed Species

Eleven state-listed bird species are documented from the EAA and five are known to occur within Compartment A. These are the little blue heron, roseate spoonbill, tricolored heron, white ibis and burrowing owl. It is likely that the eight additional state-listed wading birds occasionally use Compartment A, including the area of the preferred alternative. No nesting colonies of wading birds occur in Compartment A; however, foraging habitat will be temporarily affected by reservoir construction. Compartment A does not occur in the vicinity of off-site wading bird nesting colonies where there would be important foraging areas during the crucial nesting season. Although there will be temporary effects to wetland foraging areas used by state-listed wading birds, these mobile species will take advantage of other similar areas within the EAA. Once construction is completed, a littoral zone and other wetlands in the seepage buffer outside the reservoir will replace some foraging habitat.

Compartment A likely contains burrows of the Florida burrowing owl, based on sightings of owls by an interagency field team. This owl is a state species of special concern. These birds use dry prairies, pastures, and agricultural areas to construct their underground burrows for nesting and cover. They exhibit some nest site fidelity; however, they will not use burrows if environmental conditions are not favorable. They require open land and dry soils. If construction occurs in the vicinity of owl burrows, a take permit will be required from the State of Florida to destroy the burrow. If required, burrow destruction should be undertaken prior to the nesting season, to ensure minimal disruption to the reproductive effort of the owls. Typically, burrowing owls will construct new burrows away from areas under active disturbance. Thus, construction should be staged so that lands around the "taken" burrows are unattractive for burrow reconstruction.

The gopher tortoise, a state species of special concern, was not documented within the project site. The heavy agricultural use of most of the area and lack of deep, well-drained sands reduces the likelihood of use by tortoises.

7.10 ESSENTIAL FISH HABITAT

Excess stormwater that is discharged from Lake Okeechobee to the Atlantic Ocean through the St. Lucie River is very damaging to the St. Lucie and Southern Indian River Lagoon Estuaries. Likewise, excess stormwater discharged to the Gulf of Mexico through the Caloosahatchee River is damaging to the Caloosahatchee Estuary. The proposed EAA Storage Reservoir will reduce the volume of freshwater releases to the estuaries thereby reducing the

frequency and severity of flushing events, algal blooms, turbid water and fish kills. The proposed project is also expected to slightly improve the water quality in Lake Okeechobee thus reducing pollutant loads to the estuaries. Reducing of salinity and nutrient fluctuations caused by large pulsed fresh water flows would allow seagrass and mangrove habitat conditions in the downstream estuaries to improve. With these improvements in water quality, the appropriate conditions for sensitive estuarine biota, such as species dependent on this habitat for egg, larval, and juvenile stages, are anticipated to benefit or rebound.

All construction features of the proposed project are well inland of any Essential Fish Habitat. Standard best management practices to reduce erosion and downstream turbidity will be included in the construction specifications. The USACE has determined that construction activities would have no adverse impact on EFH in the downstream estuaries and that implementation of the project would have a positive affect on EFH.

7.11 WATER MANAGEMENT

The purpose of the Preferred Alternative is to store water from Lake Okeechobee during high water events to reduce the level in the lake, reduce regulatory releases to the estuaries, and to provide this water when it is needed to the EPA to the south. Periodic regulatory releases from the lake are expected to continue until all CERP water storage projects come on-line.

The existing water management system in the Study Area will be modified by the proposed action to enhance water storage outside of Lake Okeechobee. The Regulation Schedule of the Lake and WCAs may be adjusted to take advantage of additional off-lake water storage capacity as it is constructed and becomes operational.

Improvements to the conveyance capacity of the Bolles, Cross, North New River, and Miami Canals will improve the interconnection between the primary basins of the EAA. This will facilitate the distribution of excess surface water between basins. The benefits will include a reduction in drainage pumping from EAA basins that have received localized rainfall and a reduction in irrigation pumping to EAA basins that lack sufficient rainfall. This benefit has been demonstrated at the subbasin level as part of the success of the pumping BMPs implemented by EAA farmers.

In order to meet capacity requirements for water conveyance to the proposed storage reservoir, deepening the North New River, Cross and Bolles Canals is proposed. Pump stations and conveyance structures are proposed on the North New River canal and within Compartment A. Water would be pumped to the

proposed storage reservoir with the improved conveyance between Lake Okeechobee and the reservoir.

The principal change in water management will be an increase in the number of structures (embankments, pumps, weirs, and canals) associated with the storage reservoir and its operation. A complex operation schedule will be designed and implemented to maximize the benefits of the storage reservoir. This includes the start-up operating plan, which would be put into effect upon issuance of the water quality certification (WQC) for the construction phase of the project. The release of stored reservoir water through the STA to receiving bodies will be conducted in a gradual manner in order to ensure that reservoir releases do not adversely impact the Everglades Construction Project or Everglades Protection Area. However, water will be pumped into and out of the storage reservoir, requiring fuel, generating atmospheric emissions, and causing additional noise in the vicinity of the facilities.

7.12 WATER QUALITY

The proposed action is expected to improve water quality in the EAA, as well as in Lake Okeechobee, the Caloosahatchee Estuary, the St. Lucie Estuary, and the Everglades Protection Area (Water Conservation Areas). The proposed storage reservoir will reduce pollution loading into downstream receiving water bodies through the attenuation of surface flows and reduction of associated pollutant loads prior to discharge. The metering of water from the proposed storage reservoir into the STAs will allow them to consistently improve water quality before release to the WCAs and eventually to the EPA.

7.12.1 Lake Okeechobee

Lake Okeechobee is currently managed for many, often conflicting, uses. The Preferred Alternative will act to reduce high water conditions in Lake Okeechobee by up to eight inches compared with the future-without-project condition. It will provide no measurable improvement in low water conditions in the lake. The Preferred Alternative will reduce the volume of backpumping from the EAA into the lake through the S-2 and S-3 structures by about 1,328,898 acre-feet. This will act to reduce nutrient, trace metal, and pesticide loading to the lake, thereby incrementally improving the lake's water quality. The reduced lake levels and improved water quality will provide a positive impact to the biology of the lake's 96,000 acre littoral zone.

The primary cause of pollutant loading in Lake Okeechobee is re-suspension of nutrient-laden lake sediments during strong wind events (Reddy, et. al., 1995). The proposed action does not address this internal source of pollution.

7.12.2 Caloosahatchee River and Estuary

The Preferred Alternative will reduce the number of regulatory releases from Lake Okeechobee to the Caloosahatchee Estuary. High volume releases of water discharged from Lake Okeechobee to the Gulf of Mexico through the Caloosahatchee River are very damaging to the estuary. The proposed action will reduce these discharges by storing excess runoff from Lake Okeechobee in the proposed reservoir system and releasing the water to the south rather than the west. This will reduce the levels of non-point source pollutant loading to basin waters during the wet season, in general, and Lake Okeechobee flood control discharges in particular. The slightly improved water quality of Lake Okeechobee will result in a corresponding reduction in pollutant loads to the Caloosahatchee Estuary. In this way, the Preferred Alternative will provide some improvement for the submerged aquatic vegetation, oysters, fish, and other fauna in this estuary. The effect of the proposed reservoir is diluted by the volume of freshwater from Caloosahatchee basin runoff that will not be affected by the Preferred Alternative.

7.12.3 St. Lucie River and Southern Indian Lagoon Estuary

The Preferred Alternative will reduce the volume of regulatory releases from Lake Okeechobee to the St. Lucie Estuary. This will provide significant improvement for the 922 acres of the St. Lucie Estuary affected by the releases. This will reduce damage to the submerged aquatic vegetation, oysters, fish, and other fauna in this estuary.

7.12.4 Everglades Protection Area (EPA)

The volume, timing, and quality of water delivered to the EPA will be greatly improved by implementation of the proposed action. Significantly more water of higher quality is planned to be released into the EPA over current conditions. The proposed storage reservoir will receive water from Lake Okeechobee. That water may be used for irrigation in the EAA and/or released through STAs to the EPA. In addition to the anticipated supplementary total phosphorus removal to be achieved by the ECP STAs, southerly flows from Cell #2 may be directed through the proposed adjacent STA. If this wetland treatment yields effluent consistent with the Everglades Forever Act criteria, these reservoir flows may be routed directly to the EPA, At times when project STA effluent does not comply with EFA limits, project STA flows may be routed to yet another ECP STA so that flows to may be treated to required levels. Not only will the flow to the EPA be increased, but peak flows will be reduced, thereby reducing the impact upon the EPA ecosystems. Further, the regulation schedule for storage reservoir will provide a more consistent supply of water to the STAs, thereby allowing them to be more efficient in reducing contaminant concentrations before release to the EPA.

Releases of water from the proposed reservoir to the EPA to the south will benefit the ridge and slough habitat and particularly the tree islands in this area as compared to the future-without-project condition. The positive impacts to these habitats will be subtle. However, it will affect large areas - at least 257,586 acres of ridge and slough habitat and 11,788 acres of tree islands.

7.12.5 Canal Modification

The presence of DDT, its degradation products, and other pesticides in the sediments of the North New River, Cross, and Bolles Canals represent a potential environmental impact resulting from the proposed action. Increasing the capacity of the canals for the flow of water will require removal of a certain amount of the sediments from their respective bottoms. In order to avoid the exposure of these chemicals to adjacent soils and wetlands, the Corps would implement environmental protection measures that isolate potentially contaminated soil. The proposed action includes proper handling and disposal of contaminated sediments. This will consist of measuring levels of pesticides in undisturbed sediments, avoiding disturbance of contaminated sediments where possible, and isolating, removed contaminated sediments by installing such features as turbidity curtains and/or settling basins. Sediments would be disposed of in an approved manner, consistent with the level and nature of contamination. For example, sediment laden with compliant, albeit elevated, levels of chloro-pesticide concentrations will be either immobilized as fill material during new embankment construction; or disposed of in accordance with State environmental regulations. Thus, negative impacts from removing and managing presently unconfined contaminated sediments is planned to be minimal to non-existent.

7.13 SOCIOECONOMICS

Social and/or economic impacts that could occur with construction and operation of the Preferred Alternative are the following:

1. Induced substantial population growth;
2. Displaced on-site population;
3. Substantial employment losses; and,
4. Increased demand on community services causing service level reductions.

Construction and operation of the Preferred Alternative will not have significant direct or indirect effects on populations within the EAA or South Florida Region as measured by displaced population from Compartment A and induced population growth. The 2000 U.S Census reported 20 persons living along the eastern border of Compartment A. The purchase agreement between the DOI, SFWMD and the landowners allowed farming to continue on most of the land

until March 31, 2005. After March 2005, land could be leased for agricultural purposes until needed by the USACE for restoration purposes.

The Preferred Alternative will not have a significant effect on future population growth in other areas resulting from conversion of the site from agricultural use to a reservoir. Palm Beach County's "Agriculture Production" land use designation restricts residential development to farm labor quarters and camps, caretaker's quarters (e.g., for pump houses), and dwelling quarters and farm residences for bona fide farm operations. Consequently, future residential development potential is limited by the land use designation, whether the property remains in agricultural use or is converted to a storage reservoir.

Conversion from predominantly agricultural use to a storage reservoir will indirectly affect population by changing the type and number of employees working in the area. Agricultural employment under the preferred alternative was estimated to be 74 persons based on an employee to acreage ratio of one full-time farm worker per 289 acres of sugarcane (Roka & Cook, 1998).

The conversion to a reservoir will also eliminate the production value of sugarcane and other crops. The Preferred Alternative covers approximately 23,791 acres in sugarcane, 620 acres in row crops, and 142 acres in other agricultural lands (Water & Air Research, 2005). Sugarcane production on the Preferred Alternative in 2002 was estimated to be 469,852 tons with a value of $13.3 million or about 3.7% of total sugarcane production value in Palm Beach County.

Construction, operation, and maintenance of a storage reservoir will generate demand for workers. This will have a positive impact through direct employment and spin-off service employment within the region. The need for construction materials, such as concrete, will also be filled locally. Once completed, operation and maintenance personnel will also be needed and filled primarily from the local (i.e., West Palm, Beach-Boca Raton MSA, Miami-Ft. Lauderdale CMSA, Ft. Pierce-Port St. Lucie MSA, and Glades and Hendry Counties) area. The primary local benefits will be direct employment, direct purchase of construction materials as well as secondary/induced jobs (economic activity). Construction, operation, and maintenance employment has not been determined. Approximate construction costs are $379 million; annual operations and maintenance costs are estimated to be $28 million.

Water quality improvements in Lake Okeechobee, the Everglades, St. Lucie Estuary, and other areas resulting from the storage reservoir and other CERP projects should have a significant, positive indirect effect on economic activity in the region through revenues from increased fisheries production and an increase in tourism-related expenditures.

Increased water storage capacity should reduce agricultural flood damage thereby indirectly affecting agricultural employment. Computation of flood damages (in dollars) based on seasonality of crops within the sub-basin containing Compartment A has not yet been completed. The additional water storage should enhance economic values and social well-being in urban areas near Lake Okeechobee by reducing the number of structures affected by flooding. The storage reservoir will also increase the viability of agriculture through maintenance of high water tables, which is thought to be a key to reducing subsidence (Snyder, 2004).

Development of the storage reservoir will not have significant effects on community infrastructure and services. Infrastructure in the area is limited to roads, electric, and telephone service. Roads could be temporarily affected by traffic from construction activities; however, effects should be minor. Community services such as schools, public protection, and fire and emergency management services should be essentially unchanged.

7.14 ENVIRONMENTAL JUSTICE

In accordance with Executive Order 12898, USACE has made achieving environmental justice part of its mission. While the President's Executive Order on Environmental Justice made this directive explicit, it is implicit in NEPA and in planning regulations that USACE and SFWMD planners must conduct an objective evaluation of all project objectives in terms of their social and economic performance. This is accomplished by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. In public outreach efforts to date, the following potential environmental justice problems have been identified for the EAA Storage Reservoir project:

- Displacement of minority or low income inhabitants of land within the footprints of land purchases required for each of the EAA Storage Reservoir project alternatives.
- Change in conveyance of water required by the alternatives causing flooding or related issues that would disproportionately impact minority groups or low income class groups.
- Loss of jobs for low income and minority workers as a result of acquiring agricultural land for the construction of reservoir(s).

The EAA Storage Reservoir project is an opportunity to address these potential problems. By judicious selection of possible locations for the proposed reservoir(s) displacement of minority or low-income inhabitants has been

avoided. In addition, land that has historically been used for agriculture, but now has limited agricultural value, will be used for the EAA Storage Reservoir project. This will minimize the potential direct loss of jobs. The EAA Storage Reservoir project can support the remaining agriculture in the EAA. In fact, it could improve agriculture by augmenting water supply and flood control for the EAA. It should also be noted that the EAA Storage Reservoir project is expected to contribute to hydrological and water quality improvements in Lake Okeechobee, coastal estuaries, and the historic Everglades. In addition, reduction of backpumping EAA run-off will improve water quality in the rim canal where South Bay and Belle Glade Municipalities currently withdraw water for potable supply. Recreational benefits specific to the project are discussed in detail in Appendix D that contains a description of the recreational plan that is being proposed for EAA Storage Reservoir. Socioeconomic development activities resulting from construction of the EAA Storage reservoir should include but are not limited to construction symposiums, contract opportunity assistance for small business involvement and job cross training for local residents. These all act to make the area more attractive to visitors and in turn, may provide jobs and subsistence for low income and minority populations of the area.

7.15 LAND USE

The selected plan was analyzed for potential land use effects relative to:

1. Development trends;
2. Consistency with existing plans and policies; and,
3. Compatibility with surrounding land use.

Construction and operation of the selected plan will not have significant direct or indirect effects on development trends in the EAA. Conversion of the Preferred Alternative land area to reservoir storage will have minimal effects on growth trends since the development potential of the property is already extremely limited and the net change in employment will be small relative to EAA employment.

The Preferred Alternative will be consistent with land use plans and policies in the Palm Beach County Comprehensive Plan. Compartment A is in the Glades Tier and has an Agricultural Production land use designation. Implicit in the purchase by DOI and SFWMD is conversion of land from agricultural uses to reservoir storage and natural area. Conversion to either of these uses is consistent with the Future Land Use Plan for Palm Beach County and will not significantly affect surrounding land uses. A storage reservoir and natural areas on Compartment A would be compatible with surrounding land uses, and land

uses in the area generally, which are almost exclusively in agricultural or conservation uses.

7.16 RECREATIONAL RESOURCES

The Preferred Alternative was analyzed for potential effects to:

1. Existing recreational facilities; and,
2. Potential for future recreational usage.

Currently, there is no state or county recreational facility on Compartment A that would be affected by the EAA Storage Reservoir project. Construction and operation of a storage reservoir should increase recreational opportunities on-site and within the EAA as well as indirectly in the region when compared to existing conditions.

Recreation infrastructure would be developed consistent with the CERP Master Recreational Plan (MRP). Providing recreational opportunities is one of the C&SF Project purposes. The CERP MRP will identify and evaluate potential new recreation, public use and educational opportunities within CERP projects. Its primary purpose is to develop a comprehensive plan for recreational needs within the C&SF Project and to implement the recommendations of the MRP.

Development of the storage reservoir will indirectly improve recreational opportunities in other areas such as the Everglades and Lake Okeechobee by changing the quality, quantity, and timing of water flowing to these areas.

7.17 AESTHETICS

Visually, the EAA is quite flat with few natural topographic features. The Preferred Alternative will construct embankments and other structures to contain and operate the reservoir. These will introduce some topography to the area that will draw the eye and lend some contrast to the monotonous agricultural area. This will impact the aesthetics of the area, viewed by some as a positive change and by others as a negative change. There will also be a 200-foot wide seepage buffer on the eastern, northern, and western sides of the reservoir. This will have a mix of wetland and upland habitats. This natural area surrounding the sides of the reservoir will improve the aesthetic value of the reservoir and, over time, may conceal the lower section of the embankment. Therefore, there would be minor impacts to aesthetics associated with implementation of the proposed plan.

7.18 CULTURAL RESOURCES

Construction and operation of the Reservoir would have no effects on cultural resources. A review of the Florida Master Site Files, and a site visit determined the project site contained no recorded historical properties. The property has been heavily impacted by long-term agricultural practices and both road and canal construction, resulting in a highly disturbed landscape. SHPO concurred with the recommendation that no cultural resource survey was necessary, with the conditions that the project manager complete Archaeological Resource Manager's training or a professional archaeological consultant to be on call to perform periodic monitoring throughout the ground-disturbing phase of the project. Consultation with the SHPO for the project site (Compartment A) is complete.

The Florida Master Site Files were reviewed and site visits conducted on the major canal system within the EAA to evaluate the historical significance and the potential impact by the canal modifications to the area. SHPO expressed concern that the Bolles, Cross, Miami and New River Canals may be potentially eligible for the National Register of Historic Places since they were constructed over 50 years ago. Proposed modifications to the canals as part of the Project may have an adverse impact on the historical integrity of the canals. A documented prehistoric site is located at the junction of the Bolles, Cross and New River Canals. There are also documented historic sites on the south side of Lake Okeechobee around the junctions of Lake Okeechobee and both the Miami and North New River Canals.

Evaluation of the historical eligibility of the Bolles, Cross, Miami, and North New River Canals, and surveys of the prehistoric site at the junction of Bolles, Cross and New River Canals are currently pending.

Consultation with SHPO, site file reviews, cultural resource surveys, and determinations of significance and eligibility for listing of historic properties (archaeological, architectural, and historic resources) to the National Register of Historic Places, will continue until the Section 106 process of the National Historic Preservation Act of 1966, as amended, and 36 C.F.R., Part 800, Protection of Historic Properties, and the National Environmental Policy Act of 1969, as amended, is complete. Consultation with the Miccosukee and Seminole tribes addressing potential cultural concerns in the project area is currently underway.

If surveys locate historic properties listed or eligible for listing in the National Register of Historic Places, measures would be taken to avoid, minimize, or mitigate adverse impacts to those sites.

The Project complies with Section 106 of the National Historic Preservation Act of 1966 (PL89-665), as amended in 2000, its implementing regulations (36 Code of Federal Regulations [C.F.R.] Part 800) and the Archaeological and Historic Preservation Act of 1974 (PL93-291), as amended.

7.19 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The EAA Storage Reservoir project will involve operation of heavy equipment for construction of the storage reservoir and associated structures. Heavy equipment also will be used to increase the depth of selected canals to allow adequate movement of water between Lake Okeechobee and the proposed storage reservoir. The sediments of these canals contain pollutants that require proper handling. Both the equipment and contaminated sediments represent potential for hazardous and toxic material and waste to be released to soils and waters of the area.

Operation of heavy equipment requires fuel, lubrication, hydraulic fluid, and some field maintenance. Fueling stations may have spills associated with filling field tanks or transferring fuel to equipment. Tanks may also develop leaks under typical field conditions. Equipment may experience failures and/or accidents that release fluids.

Though pesticide levels in some canal sediments will require careful handling to keep the pesticides from dispersing into the ambient environment, it should be noted that contamination of the environment is not anticipated. Despite the nature of the dredging operations and the quantity of materials that will be handled, the implementation of procedures mentioned in Section 8 should prove adequate in the prevention of non-compliant pesticides exposure.

7.20 TRANSPORTATION, UTILITITES, AND PUBLIC INFRASTRUCTURE

7.20.1 Effects to Bridges and Intakes:

1. FDOT Bridges - Two bridges will be affected by the increased conveyance for the NNR Canal. The two bridges are those for SR-80 and SR-827 that cross over the NNR Canal. One bridge (US 27) would be affected by the increased conveyance requirement for the Bolles Canal. Replacement of the bridges will be done in close coordination with FDOT during the project design phase, if approved. The bridges would be designed and constructed in accordance with both FDOT and USACE standards. When in conflict, the most stringent standard will apply. Construction of the bridges will be done to maintain traffic at all times by sequencing demolition and construction one lane at a time with alternating one way traffic. All safety, signage, flagging, etc. requirements will be included in the design.

2. Railroad Bridges - Three railroad bridges would be affected by the increased conveyance requirements for the NNR and Miami Canals. One railroad bridge crosses the NNR and two cross the Miami Canal. The bridge across the NNR is owned by Florida East Coast Railway (F.E.C. RY.). Of the two bridges across the Miami Canal, one is owned by U.S. Sugar Corp; the second is owned by Seaboard System Railroad. Replacement of the affected bridges will be in close coordination with the owners and to the applicable railroad design and construction standards. An attempt to maintain railroad traffic across the NNR and Miami Canals will depend on rerouting shipments where possible, during the demolition and construction of any of the impacted bridges. In the case that traffic can not be rerouted or maintained in any other way, a temporary bridge will be erected beside the existing bridge during the construction of the new bridge.
3. Privately Owned Agricultural Traffic Bridges - Nine privately owned bridges would be affected by the increased conveyance requirement for the NNR. Two privately owned bridges would be affected by the increased conveyance requirement of the Miami Canal. Five privately owned bridges will be affected by the increased conveyance requirement of the Cross Canal. One privately owned bridge will be affected by the conveyance requirement of the Bolles Canal. These bridges will be replaced in kind, type and size, and meeting present day FDOT standards and requirements. The bridges will be replaced in a manner that will interrupt traffic for the agricultural haulers and vehicular traffic as little as possible. There are enough bridges and they are close enough to each other that traffic can be rerouted. Traffic on the levees along the canal banks is an everyday event and we do not foresee problems with rerouting traffic through other bridges while others are being replaced.
4. Pump Station Intake Structures and Other Control Structures - There are many of these categories of structures that will need to be replaced due to the canal improvement work. Each structure will be replaced with the same type, capacity and operationally sound structure. Interim pumps will be provided for critical water supply canals during normal flow interruption.

7.20.2 Utility Re-Alignments

Utility relocation is anticipated in conjunction with the replacement of two bridges. Fiber optic communication lines are attached to one bridge, and a water main to the other. Relocation of utilities attached to bridges will be included as part of the bridge construction project. A high voltage electrical transmission line, and an aerial electrical distribution line and telephone line will also require relocation due to canal improvements near Lake Okeechobee. Relocation of an overhead electrical distribution line and telephone line that crosses through the

reservoir area is also anticipated. The need for additional required utility relocation may be found once pre-construction project survey information is available.

7.20.3 Effects to Roadways:

New Structure on U.S.-27 - A new structure (S-609) will need to be constructed on U.S.-27 in order to provide access from the EAA Reservoir Cell 1 to the NNR Canal. This will be a new bridge or gated culvert structure. Design and construction of this structure, bridge or culvert, will be done in close coordination with FDOT since the beginning of the Design Phase. The structure would be designed and constructed in accordance with both FDOT and USACE standards. When in conflict, the most stringent standard will apply. Construction of the structure will be done in a manner in which traffic will be maintained at all times. This will be accomplished by constructing one half of it at a time, alternating one way traffic. All support infrastructure, safety, signage, flagging, etc. requirements will be included in the design.

7.20.4 Summary of Improvements

1. North New River (NNR) - Structures are itemized from north towards south along the canal. The following structures exist along the banks of the NNR or cross over it.

Railroad Bridges	1	Owned by Florida East Coast Railway. Located 1,330 LF north of SR-80 along the NNR. Bridge affected by canal enlargement and will have to be replaced.
FDOT Bridges	2	One is the SR-80 bridge over NNR, and the second is the SR-827 bridge over NNR. Bridge affected by canal enlargement and will have to be replaced.
Privately Owned Bridges	9	Mainly owned by agricultural companies in the area. Providing access from sugar cane fields east of NNR to U.S. 27 on the west side. Bridge affected by canal enlargement and will have to be replaced.
Privately Owned Pump Stations and Intake Structures	10	Mainly owned by agricultural companies in the area. Supplying water from NNR to sugar cane fields. Intake structures consist of submerged pipes with a few Ogee type spillways. Intake structures affected by canal enlargement and will have to be replaced. Pump stations are mostly far enough from NNR bank probably not to be affected by project.
Other Structures	9	Mainly owned by agricultural companies in the area. Supplying water from NNR to sugar cane fields. Intake structures consist of gated pipe culverts and Ogee type spillways. Intake structures affected by canal enlargement and will have to be replaced.

2. Miami Canal - Structures are itemized from north towards south along the canal. The following structures exist along the banks of the Miami Canal or cross over it:

FDOT Bridges	4	Two, double span bridges over Miami Canal in the vicinity of Hoover Dike. These two bridges will not be affected by the project. One abandoned bridge or remains of it. This bridge is outside of the limits of the canal improvements. One Old U.S. 27 bridge over Miami Canal. This bridge will not be affected by the project.
Railroad Bridges	3	One railroad bridge owned by Florida East Coast Railway (F.E.C. RY.). This bridge will not be affected by the project. One railroad and vehicular bridge owned by U.S. Sugar Corporation will be affected by canal enlargement and will have to be replaced. One railroad bridge owned by Seaboard System Railroad will be affected by canal enlargement and will have to be replaced.
Privately Owned Bridges	2	Mainly owned by agricultural companies in the area. Providing access from sugar cane fields from east to west and vice versa over the Miami Canal. The bridges will be affected by canal enlargement and will have to be replaced.
Privately Owned Pump Stations and Intake Structures	4	Mainly owned by agricultural companies in the area. Supplying water from Miami Canal to sugar cane fields. Intake structures consist of submerged pipes with a few Ogee type spillways. Intake structureswill be affected by canal enlargement and will have to be replaced. Pump stations are mostly far enough from canal bank probably not to be affected by the project.
Other Structures	11	Mainly owned by agricultural companies in the area. Supplying water from canal to sugar cane fields. Intake structures consist of gated pipe culverts and Ogee type spillways. The Intake structures will be affected by canal enlargement and will have to be replaced.

3. Cross Canal - Structures are itemized from west towards east along the canal. The following structures exist along the banks of the Cross Canal or cross over it:

Privately Owned Bridges	5	Mainly owned by agricultural companies in the area. Four are bridges and one consists of culverts under Duba Road across the canal. Providing access from sugar cane fields from north to south and vice versa over the Cross Canal and from and to SR-827. The bridges will be affected by canal enlargement and will have to be replaced.
Privately Owned Pump Stations and Intake Structures	3	Mainly owned by agricultural companies in the area. Supplying water from Cross Canal to sugar cane fields. Intake structures consist of submerged pipes with a few Ogee type spillways. The intake structures will be affected by canal enlargement and will have to be replaced. Pump stations are mostly far enough from canal bank probably not to be affected by the project.

4. Bolles Canal - Structures are itemized from east towards west along the canal. The following structures exist along the banks of the Bolles Canal or cross over it:

FDOT Bridges	1	US-27 bridge over Bolles Canal will be affected by canal enlargement and will have to be replaced.
Privately Owned Bridges	1	Consists of culverts under a road crossing the canal. Owned by agricultural Company. This crossing will be affected by canal enlargement and will have to be replaced.
Privately Owned Pump Stations and Intake Structures	2	Mainly owned by agricultural companies in the area. Supplying water from Bolles Canal to sugar cane fields. Intake structures consist of submerged pipes with a few Ogee type spillways. The intake structures will be affected by canal enlargement and will have to be replaced. The pump stations are mostly far enough from canal bank probably not to be affected by the project.
Other Structures	4	Mainly owned by agricultural companies in the area. Supplying water from canal to sugar cane fields. The intake structures consist of gated pipe culverts and Ogee type spillways. The intake structures will be affected by canal enlargement and will have to be replaced.

7.21 UNAVOIDABLE ADVERSE IMPACTS

7.21.1 Soils

Approximately 31,473 acres of unique farmland soils will be permanently converted to reservoir bottoms on the proposed project site.

7.21.2 Land Use (Agriculture)

About 33,500 acres of agricultural lands will be permanently removed from production due to the construction of the proposed large above-ground storage reservoir, STA, and associated features.

7.21.3 Wetlands

Approximately 206 acres of functional wetlands and approximately 33,294 acres of atypical (agricultural) wetlands would be permanently altered within the project footprint.

7.21.4 Water quality

Temporary increases in turbidity of local waters are expected from the deepening of canals and by the construction of the components of the large above-ground storage reservoir.

7.21.5 Air quality

Fugitive dust and vehicle exhaust from vehicular traffic and earth moving will be unavoidable.

7.21.6 Fish and Wildlife Resources

Localized, temporary disturbances to fish and wildlife are expected from deepening of canals and construction of embankments and other structures.

7.21.7 Threatened and Endangered Species

Usable habitat for the Florida Panther may be reduced.

7.21.8 Recreation

Limited, temporary impacts to recreation resources (canal fisheries for example) are expected during construction.

7.22 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Construction of the EAA Storage Reservoir project will include many features considered permanent as well as modifications to existing C&SF Project features, which may be deemed irreversible. This will include construction of an approximately 31,000 acre reservoir and deepening of approximately 38 linear

miles of canals. Such construction and structural modifications are proposed on such a scale that these features represent an irreversible and irretrievable commitment of resources.

Resources to be committed if the project is approved include state and federal funding to purchase lands and labor, energy and project materials to build, operate, and maintain the Project. Fish and wildlife habitat will be permanently altered (converted to open water, particularly in the case of a storage reservoir). These lands will likely be inundated for much of the year. Another resource that may be impossible to replace is the caprock. It is proposed to be broken at the top of the limestone formation underlying the soils in the area of the EAA Storage Reservoir project. In addition, soils classified by the USDA/NRCS as Unique Farmland would be permanently taken from agricultural use.

7.23 CUMULATIVE EFFECTS

The EAA Storage Reservoir project is a proposed part of the CERP. Large areas north of Lake Okeechobee, within the EAA, around the lake, in the Caloosahatchee River Basin, and on the Upper East Coast will be used to increase water storage for the overall gain and long-term benefit of the regional system. These project features will provide important storage functions and are essential to the overall restoration of the freshwater marshes and the estuaries of the area.

The CERP contains 68 components that total approximately 217,000 acres of new reservoirs and wetlands-based water treatment areas. This plan increases the supply of fresh water for the Everglades and South Florida ecosystem and improves the quantity, quality, timing, and delivery of water to the natural system. CERP includes the following structural and operational changes to the existing C&SF Project:

- Construction of 181,250 acres of surface water storage reservoirs with a capacity to store 1,543,270 acre-feet of water;
- WPAs consisting of multi-purpose water management areas in Palm Beach, Broward, and Miami-Dade Counties between urban areas and the eastern Everglades;
- Aquifer storage and recovery (ASR) wells around Lake Okeechobee, in the WPAs, and in the Caloosahatchee River basin capable of pumping as much as 1.6 billion gallons of water a day;
- Construction of 35,600 acres of STAs;
- Removal of more than 240 miles of project canals and internal embankments within the Everglades;

- Modifications to 11,000 acres of existing limestone quarries in the Lake Belt region of northern Miami-Dade County for water storage for urban areas and the natural environment;
- Construction of new wastewater reuse facilities and modifications to an existing waste water reuse facility to supply up to 220 million gallons per day of treated, clean water to the natural system; and
- Pilot projects to address uncertainties associated with some of the physical features that are proposed in the CERP.

A number of operational components have also been identified in the CERP and will, in most cases, occur in conjunction with related construction features. The operational features in the CERP include: a modified Lake Okeechobee regulation schedule; environmental water supply deliveries to the Caloosahatchee and St. Lucie Estuaries; modifications to the regulation schedules for WCAs 2A, 2B, 3A, 3B, and the current rainfall delivery formula for ENP; modified Holey Land Wildlife Management Area Operations Plan; Modified Rotenberger Wildlife Management Area Operations Plan; a modification for coastal wellfield operations in the Lower East Coast (LEC); LEC utility water conservation; and operational modifications to the southern portion of L-31N and C-111.

Project features will cause some adverse consequences to agricultural land uses - permanently removing tens of thousands of acres from agricultural production. These impacts may be felt locally and/or regionally as the economic base derived from agriculture is incrementally reduced relative to other sectors of the economy. The overall benefit to the regional system is expected to be far greater than the localized adverse effects. As these features occur disparately across the landscape within different hydrologic basins, and as distinct units rather than multiple features within a single watershed, they will not likely result in a significantly detrimental cumulative effect.

The EAA Storage Reservoirs project is part of the CERP. Large areas north of Lake Okeechobee, within the EAA, around the lake, in the Caloosahatchee River basin, and on the upper east coast are anticipated to be used to increase water storage for the overall gain and long-term benefit of the regional system. These project features will provide important storage functions and the Restudy deemed them essential to the overall restoration of the freshwater marshes and the estuaries and the downstream Everglades. Project features will cause some adverse consequences to agricultural land uses - permanently removing tens of thousands of acres from agricultural production. These impacts may be felt locally and/or regionally as the economic base derived from agriculture is incrementally reduced relative to other sectors of the economy. The overall benefit to the regional system is expected to be far greater than the localized adverse effects. As these features occur disparately across the landscape within

different hydrologic basins, and as distinct units rather than multiple features within a single watershed, they will not likely result in a significantly detrimental cumulative effect.

As part of the CERP, the proposed EAA reservoirs will benefit South Florida ecosystems. Specifically, the proposed EAA reservoirs will benefit the St. Lucie and Caloosahatchee Estuaries and Lake Okeechobee as well as improve the quality and timing of water delivery to the STAs for improved water treatment within the STAs.

Benefits to the Caloosahatchee and St. Lucie Estuaries will result from reducing the extreme discharges to the estuaries. Ecological benefits from this project, in addition to other CERP projects, include:

- Salinities in the riverine portions of the Caloosahatchee River will increase to allow oyster reef growth;
- Expansion of 18 acres of oyster beds in the Caloosahatchee Estuary to 100 acres in the next 10 to 15 years;
- Increase the spatial extent and improve the function of submerged aquatic vegetation the Caloosahatchee River and Estuary;
- Salinities in the St. Lucie Estuary will be between 350 to 2,000 cfs to allow oyster reef growth;
- Expansion of oyster beds in the St. Lucie Estuary to approximately 890 acres of oysters;
- Increase the spatial extent and improve the function of submerged aquatic vegetation the St. Lucie Estuary; and,
- Increase the health of fish in the St. Lucie and Caloosahatchee Estuaries by reducing prolonged discharges of large volumes of lake water. Rather than relying on Lake Okeechobee to provide water storage, use of the proposed EAA reservoirs with other CERP reservoirs and ASR for water storage will have beneficial effects to the health and ecology of the lake. Reduction of extreme high and low lake levels will:
- Increase the amount and quality of submergent and emergent plant communities in Lake Okeechobee; and,
- Improve foraging and habitat for wading birds and native fish.

Some improvement of Lake Okeechobee water quality could be expected as a result of operations of the proposed EAA project, which will redirect EAA stormwater runoff to the reservoirs rather than directly to Lake Okeechobee.

Improvements to the water quality entering the WCAs will result from the ability to more effectively store water within the proposed EAA reservoirs by metering peak flows in the STAs. STAs are intended to provide treatment rather than store water; however, during the wet season and flood events, they

have been used to provide both functions. Creation of the reservoirs will provide the needed storage function, allowing the STAs primary use as water treatment facilities. Increased residence times of water within the STAs will ensure better treatment of waters released to the WCAs and have beneficial water quality effects on all downstream ecosystems.

SECTION 8
PLAN IMPLEMENTATION

This page intentionally left blank

8.0 PLAN IMPLEMENTATION

The conditionally authorized Phase 1 EAA Project has been reevaluated. It has been determined that to optimize the design, it is no longer necessary to phase this Project. The three reasons for initially phasing this Project were because it was believed that:

1. Only a portion of that lands needed for the entire project had been acquired by the DOI and SFWMD,
2. There was an opportunity to construct a portion of this Project in a manner that is mutually beneficial for the Comprehensive Plan and the sponsor's Everglades Construction Project,
3. The expedited construction of portions of this Project would provide multiple environmental, water supply, and flood protection benefits.

Because it has been determined that all benefits anticipated for this Project can be achieved with lands already acquired, there is no longer any need to phase the implementation.

8.1 DIVISION OF IMPLEMENTATION RESPONSIBILITIES

Responsibilities for implementing the Selected Alternative Plan (Selected Plan) will be shared by USACE, on behalf of the Federal government, and the non-Federal sponsor, SFWMD. USACE and SFWMD will cost share equally in the design of the projects resulting from this plan. SFWMD has acquired the necessary lands, easements, rights-of-way, relocation, and disposal areas (collectively referred to as LERRD) and will operate and maintain the completed Project. Construction contracts to build the projects will be managed by either USACE or SFWMD to maintain a 50/50 cost. Rules, which determine how project responsibilities are shared, are established in federal law and related implementing policies. Section 601 of WRDA 2000 provides in-kind cost sharing credit to the non-federal sponsor for design, construction and operational and maintenance and for treatment of credit between projects to maintain a 50/50 cost share. The draft PIR includes recommendations to credit the non-federal sponsor for work completed under the Acceler8 program in advance of approval and authorization of the federal project. At this time, it is anticipated that the Selected Plan will include SFWMD's Acceler8 project for the EAA Storage Reservoir (190,000 acre-feet of storage and appurtenant structures and features).

Detailed design of the Acceler8 project will be accomplished by SFWMD with coordination and review by USACE under the Acceler8 program. All project features will be designed in accordance with USACE regulations and standards. Construction activities for the Acceler8 project will be in accordance with the Acceler8 program and will be the responsibility of SFWMD. Crediting for work

performed by SFWMD will be subject to project authorization and adherence to USACE design standards and regulations.

8.1.1 Project Implementation Schedule

The EAA Storage Reservoir Final PIR/EIS is currently scheduled for April 2006. Upon approval and authorization, construction of the federal project can begin as early as 2008 depending on the availability of the federal appropriation, and is expected to be completed in 2011. Detailed design and engineering analysis in support of initiation of construction activities commenced in 2005 under the Acceler8 program with survey, subsurface geotechnical investigations and a basis of design report. Construction is expected to begin on Acceler8 project in May 2006. The Acceler8 project is expected to be completed in 2009.

8.1.2 Pre-Construction Engineering and Design Activities

Pre-construction engineering and design activities will be in accordance with the joint USACE and SFWMD Acceler8 program. Preliminary design activities, which include survey and geotechnical investigations as well as cultural resources compliance, commenced in early 2005. Under the Acceler8 program, SFWMD has prepared a Basis of Design Report (BODR) for the EAA Storage Reservoir Acceler8 project. The BODR includes all engineering assumptions and conceptual designs for the Acceler8 project features. Upon final approval of the BODR, SFWMD will prepare initial, intermediate, and final plans and specifications for construction contract award. All design work will be coordinated and reviewed with USACE to ensure that the work to be constructed as part of the Acceler8 project will meet USACE standards and regulations.

Operation of the EAA Storage Reservoir selected plan involves capturing and storing regulatory releases from Lake Okeechobee and runoff from the Everglades Agricultural Area (EAA) and subsequently delivering the stored water for both water supply to the EAA and to meet hydrologic targets in the Water Conservation Areas (WCAs) and Everglades National Park (ENP). Although the selected plan works in concert with Stormwater Treatment Area 3/4 (STA 3/4) of the State of Florida's Everglades Construction Project, it is anticipated that the additional hydraulic and phosphorus loading associated with delivering additional water to the WCAs and ENP to meet hydrologic targets will occasionally exceed the treatment capacity of STA 3/4. To ensure that water that is to be delivered to the WCAs and ENP meets water quality requirements, a conceptual stormwater treatment area is included in the EAA Storage Reservoir selected plan.

Real estate, engineering, design and construction and maintenance costs for the stormwater area treatment area have not yet been added to the costs of the project, as a conceptual design has not yet been completed. Current rough order

of magnitude costs for the proposed STA include an estimated real estate cost of $8,176,000 and cost estimates for construction ranging from $57,800,000 to in excess of $150,000,000, based on comparative costs of similar construction. A reconnaissance level cost estimate will be prepared for the Final PIR/EIS. Additional analysis will be conducted during the detailed engineering and design phase of the project to refine the design, costs, and operations of the stormwater treatment area

8.1.3 Implementation of Project Operations

The Draft Project Operating Manual for the EAA Storage Reservoir Project (see Annex D) will be modified and revised, as necessary, through several project phases. During the Detailed Design and Plans and Specifications Phase, the Draft Project Operating Manual will be modified as needed to define temporary operations to be used during construction. These temporary operations are also known as Interim Operations during Construction. As construction of the project nears completion, the Draft Project Operating Manual will be further modified to focus on operations during the Operational Testing and Monitoring Phase. Knowledge gained from the Operational Testing and Monitoring Phase will then be incorporated into a revision of the Draft Project Operating Manual, which will be coordinated with SFWMD and the USACE South Atlantic Division (SAD), and will supersede all other iterations of the Draft Operating Manual. The final version of the Project Operating Manual will be used by SFWMD when the SFWMD accepts responsibility for long-term operations of the project.

8.2 COST SHARING

Responsibilities for implementing the Selected Plan will be shared by USACE, on behalf of the Federal government, and the non-Federal sponsor, SFWMD. The USACE and SFWMD will cost-share equally in the design of the projects resulting from this plan. The SFWMD has acquired the necessary lands, easements, rights-of-way, relocation, and disposal areas (collectively referred to as LERRD); and operate and maintain the completed project. Construction contracts to build the projects will be managed by either USACE or SFWMD to maintain as close to a 50/50 cost share as possible to meet the overall CERP program goal of a 50/50 federal/non-federal cost share.

Rules, which determine how project responsibilities are shared, are established in Federal law and the Administration's implementing policies. Section 601 of WRDA 2000 provides in-kind cost sharing credit to the non-Federal sponsor for design, construction, and operational and maintenance and for treatment of credit between projects to maintain a 50/50 cost share. The PIR recommends crediting the non-Federal sponsor for work completed under the Acceler8 program in advance of approval and authorization of the Federal project. Also, since recreational opportunities are one of the original CERP objectives,

planning, design, and construction of recreation features are cost-shared equally by the Federal government and the non-Federal sponsor; however, operation and maintenance of the recreation features is a non-Federal responsibility.

8.2.1 Cost Apportionment

Table 8-1 includes an apportionment of construction of the Selected Plan.

TABLE 8-1: COST APPOINTMENT OF THE 12-FOOT DEEP EARTHEN EMBANKMENT PLAN

Item	Total	Federal	Non-Federal
Construction	$795,261,089	$372,739,545	$422,521,545
LERRD*	$80,134,000	$64,958,000	$15,176,000
PED	$37,500,000	$18,750,000	$18,750,000
Total*	$912,895,089	$456,447,545	$456,447,545

***Does not include proposed STA costs.**

The LERRD cost apportionment includes $64,958,000 in credit to the Federal portion of the project. These were federal funds provided by the Department of Interior (DOI) for the purchase of lands in Compartment A of the Talisman Land Exchange pursuant to Section 390, of the Federal Agriculture Improvement and Reform Act of 1996 (Public Law 104-127, 110 Stat. 1022). The $64,958,000 contributed by DOI pursuant to the Farm Bill (Section 390 of the Federal Agriculture Improvement and Reform Act of 1996; Public Law 104-127, 110 Stat. 1022) is to be credited to the Federal share of the project cost pursuant to Section 601 (e)(3) of the Water Resources Development Act of 2000.

8.3 PROJECT OPERATIONS

Revisions to the initial Draft Project Operating Manual will be completed during the Detailed Design Phase to refine project operations. This revised Project Operating manual will incorporate any modifications from the Detailed Design Phase and when practicable, include actions related to improving water quality. USACE and SFWMD will share in the responsibilities for conducting water management operations during the Operational Testing and Monitoring Phase. After long-term operations are underway by the non-Federal sponsor, if changing conditions (including implementation of other CERP projects and non-

CERP activities) require revisions to the Project Operating Manual, those revisions will be completed in accordance with the process outlined in the CERP Programmatic Regulations and applicable USACE regulations, consistent with applicable NEPA requirements.

8.4 PROJECT ASSURANCES

This project implementation report includes the identification of water for the natural system and the identification of water for other water-related needs of the south Florida region from the project. It also evaluates the project's effects on existing legal sources of water and effects on the level of service for flood protection as required by WRDA 2000, and addresses related state assurances requirements.

The hydrologic modeling, analytical procedures, and calculations performed for these initial evaluations were generally based on the information contained and the procedures developed for the draft programmatic guidance memoranda 3 ("Savings Clause Requirements") and 4 ("Identifying Water Needed to Achieve the Benefits of the Plan"). Because the guidance memoranda have not been finalized, all of the data and information contained in this draft report are considered to be preliminary and subject to change as a result of further evaluations that may be performed to maintain consistency with the approved final programmatic guidance memoranda. An explanation of the hydrologic modeling, evaluation methods, and the results of these evaluations is included in Annex G ("Legislative and Statutory Requirements") of this report

8.4.1 Level of Service for Flood Protection

The primary purpose of the Project is to store runoff from the EAA and discharges from Lake Okeechobee to improve ecological functions in Lake Okeechobee, the St. Lucie and Caloosahatchee Estuaries, and the EPA. The storage of up to 360,000 acre-feet of water in an above ground reservoir operated at a normal above ground pool depth of 12 feet will incidentally improve flood protection by removing 32,000 acres from the drainage basin. A reservoir of this size may be expected to increase average elevations of groundwater in adjacent lands unless appropriate flood mitigation measures are included as part of the TSP. Sub-regional hydrologic modeling conducted using the MODFLOW (a three-dimensional groundwater flow model) and SEEP/W (a two-dimensional finite element model) to determine the TSP's effects on the level of service for flood protection in effect as of December 2000.

An initial evaluation of potential project effects has been conducted for the Project using the MODFLOW model. The results of the initial evaluation indicate that the Project may increase groundwater elevations in portions of STA 3/4 adjacent to the Project and in a small area of the Holey Land WMA. A slight

increase in groundwater elevations beneath STA 3/4 is not expected to adversely affect water quality treatment functions of that project and can be further managed by project surface water operations considering these groundwater deliveries. The effects within the Holey Land WMA are confined to within approximately 500 to 1000 feet of the EAA Storage Reservoir Project footprint, and are not expected to adversely affect fish and wildlife habitat and recreational use functions of that area and can be further managed by project surface water operations considering these groundwater deliveries

The selected plan includes a buffer area surrounded by a seepage collection canal including seepage return pumps to manage seepage within the project footprint. Due to the inclusion of this feature, the initial evaluation did not indicate that there was an effect on groundwater elevations in agricultural lands north of the project site beyond the project footprint due to the southeasterly gradient of groundwater in this area. The design of the selected plan also includes a cutoff wall beneath the levee to provide additional stability and seepage control. The cutoff wall would provide additional control of seepage resulting from the hydraulic head created by the storage of water in the reservoir. This feature is included in the cost estimate for the selected alternative plan. Due to the location of the proposed buffer and seepage collection system west of the FDOT right-of-way for US 27 and the results of the preliminary hydrologic and hydraulic modeling analyses to date, which indicate that the proposed EAA Reservoir project is not expected to result in increased water levels in adjacent canal systems, the EAA Reservoir Project is not expected to adversely impact the integrity of US 27.

8.4.2 Effects on Legal Sources of Water

In general, the Project is designed to reduce damaging high water levels in Lake Okeechobee and reduce the volume, frequency, and duration of ecologically damaging discharges to the Caloosahatchee and St. Lucie estuarine systems. The Project is also intended to collect and store runoff from the EAA and to provide a supplemental source of water for agricultural users in the EAA and an additional source of water for fish and wildlife in WCAs 2 and 3.

In accordance with Section 601(h) (5) (A) of WRDA 2000 (P.L. 106-541), CERP projects may not eliminate or transfer existing (as of December 2000) legal sources of water for:

- agricultural or urban water supplies;
- an allocation or entitlement to the Seminole Tribe of Florida;
- the Miccosukee Tribe of Indians of Florida;
- water supply for Everglades National Park; or
- water supply for fish and wildlife

Until a new source of water of comparable quantity and quality is available to replace the water lost as a result of project implementation.

The analysis of effects on existing legal sources was conducted by evaluating water supply performance measures, including stage and volume probability curves for basins and/or indicator regions and water budget data produced by the South Florida Water Management Model. To identify project effects, the regional water management system, including the operations of the selected plan, was simulated with the regional model, and the modeled outputs were compared to those produced for the base condition representative of conditions as of December 2000 (the Pre-CERP Baseline).

To evaluate project effects on the legal sources for the above-listed user groups, the sources supplying water to those user groups as of December 2000 must be identified and the project's potential effects on those sources must be evaluated.

In general, the selected plan increases the quantity of water available from existing legal sources for agricultural and urban water supplies, Seminole and Miccosukee Tribal water supplies, Everglades National Park, and fish and wildlife compared to Pre-CERP Baseline quantities. Implementation of the selected plan will also result in a transfer of a portion of the existing legal source for agricultural water supply in the Everglades Agricultural Area from Lake Okeechobee to water supplied by the reservoir. However, implementation of the selected plan will not preclude operation of the C&SF project to deliver water from Lake Okeechobee to meet agricultural water supply needs or to the WCAs and Everglades National Park to meet environmental demands for water supply in those areas. Therefore, no additional sources of water need to be identified due to the partial transfer resulting from project implementation since Lake Okeechobee will continue to provide water to agricultural users and the WCAs and Everglades National Park. An explanation of the modeling performed, analytical methods, and the results of this evaluation are contained in Annex G of this report.

8.4.3 Identification of Water to be Made Available for the Natural System

As discussed above, the EAA Storage Reservoir Project is intended to beneficially affect environmental conditions in Lake Okeechobee, the St. Lucie and Caloosahatchee Estuaries, and the Water Conservation Areas and Everglades National Park.

Beneficial effects in Lake Okeechobee and the Caloosahatchee and St. Lucie Estuaries are achieved by reducing harmful water levels in Lake Okeechobee and the volume, frequency, and duration of damaging freshwater discharges to

the estuaries via the C-43 (Caloosahatchee) and C-44 (St. Lucie) Canals. For these three benefit regions (Lake Okeechobee, St. Lucie Estuary, Caloosahatchee Estuary), the primary beneficial environmental effect is to improve fish and wildlife habitat in those areas by lowering damaging high water levels and by reducing damaging discharges of freshwater; therefore, the selected plan was not formulated and will not be operated to make available additional water for the protection of fish and wildlife in those areas. However, the existing water delivered to those areas for the protection of fish and wildlife was considered as part of the evaluation performed to identify and quantify the beneficial effects of the project.

To identify the quantity of water made available by the selected plan for the protection of fish and wildlife in the Water Conservation Areas and Everglades National Park, the selected plan's effects were evaluated by comparing depth and flow volume probability curves using data produced by the South Florida Water Management Model. To identify project effects, the regional water management system including the operations of the selected plan were simulated with the model and the modeled outputs were compared to those produced for the base condition representative of current conditions (the Existing Condition PIR Baseline).

The results of this evaluation indicated that the selected plan will provide additional water for the protection of fish and wildlife in WCAs 3A and 3B and Everglades National Park, which will be reserved or allocated for the natural system under State of Florida law in accordance with the requirements of Section 601(h)(4) of the Water Resources Development Act of 2000. A detailed explanation of the modeling performed, analytical methods, and the results of these evaluations are contained in Annex G of this report.

8.4.4 Identification of Water for Other Water-Related Needs

In addition to maintaining the quantity of water available to meet water supply demands as of December 2000 and increasing the quantity of water available that is beneficial for the protection of fish and wildlife, it is also anticipated that some CERP projects, including the EAA Storage Reservoir project, will increase the amount of water available for other water-related needs of South Florida, including providing water to meet additional and future water supply demands and for the prevention of saltwater intrusion into the freshwater aquifer.

Similar to the process for identifying water made available for the protection of fish and wildlife, to evaluate the selected plan's effects on water for other water-related needs, the selected plan was modeled with the South Florida Water Management Model and the modeled outputs were compared to those produced for the base condition representative of current conditions (the Existing

Condition PIR Baseline). The selected plan's effects were evaluated by comparing water supply performance measures and water budget data for those basins affected by the project.

The results of the evaluation indicate that selected plan will increase the quantity of water available in the C&SF Project to meet water supply and resource protection needs. A detailed explanation of the modeling performed, analytical methods, and the results of these evaluations are contained in Annex G of this report.

8.5 PROJECT WATER QUALITY MONITORING PLAN

The objective of the EAA Storage Reservoir Water Quality Monitoring Plan is to provide accurate data that will permit the evaluation of changes in the quality of the waters as a result of construction and operation of proposed project. A separate ecological plan will also monitor and/or evaluate monitoring data descriptive of ecosystem responses to habitat enhancement in the littoral and seepage zones and improved treatment within the STAs that are expected to provide effluent of a quality (less than 10 ppb P) suitable for release into the EPA. In addition, the final monitoring should provide information on the engineering components [reservoirs, STAs, and restored habitats] efficiencies ultimately supporting the adaptive management process.

Restoration Coordination and Verification (RECOVER) and the project delivery team (PDT) recognize that the effects from implementing the CERP projects must be monitored at both system-wide and local scales. The design and implementation of system-wide monitoring is the responsibility of RECOVER, while the design and implementation of monitoring to determine local effects and project performance is the responsibility of the PDT. To implement the system-wide program, RECOVER has developed the CERP Monitoring and Assessment Plan (MAP). However, the MAP does not extend comprehensively into the EAA. As a result, the RECOVER system-wide monitoring plan was not available to be referenced for development of the project-specific plan. The local project monitoring plan will be based upon applicable northern everglades elements identified in the SFWMD's DBHYDRO database that, due to location, can be used to collect data at strategic locations. Project specific monitoring shall be coordinated to ensure that measures and targets selected by the project teams are consistent with system-wide measures and that duplication of effort is avoided. The EAA Storage Reservoir Phase I Water Quality Monitoring Plan will utilize the results of pre-existent, routine SFWMD monitoring efforts within the project area of the EAA whenever possible. In order to detect project-induced changes to water quality, different or additional parameters and sampling sites shall be incorporated into this monitoring plan for the collection of data immediately upstream and/or downstream of key reservoir structures

during the pre-construction engineering and design (PED) phase. The monitoring schemes for the project are detailed in Annex F and summarized in Table 8-2.

TABLE 8-2: SUMMARY OF MONITORING PROGRAM FOR CERP EAA RESERVOIR

Medium	Group	Parameters	Construction	Startup	Stabilization (Preliminary Flow-Through)	Normal Flow-Through (Long-Term)
Water	Field Parameters	Dissolved oxygen, conductivity, pH, temperature		Probe, Bi-weekly, at inflow and outflow	Probe, monthly, at inflow and outflow	Probe, monthly, at inflow and outflow*
Water	Nutrients	TP, TRP (total reactive ortho-P), TKN, NH3, NO2+3		Grab, monthly, at inflow and outflow	Grab, monthly, at inflow, outflow and structure located in berm between compartments	Grab, monthly, at inflow and outflow
Water	Physical Alkalinity	Chloride,Hardness, turbidity, TSS, color	Turbidity only*	Grab, monthly at inflow and outflow	Grab, monthly at inflow and outflow	Grab, monthly, at inflow and outflow*
Water	Trace Metals	Cu		Grab, at end of startup, at inflow and outflow	Grab, monthly at inflow and outflow	Grab, monthly at inflow and outflow**
Water	Trace Metals	As, Fe, Zn		Grab, at end of startup, at inflow and outflow	Grab, quarterly, at inflow and outflow	Grab, quarterly, at inflow and outflow
Water/Soil (Sediment)	Pesticides +	W-PEST-CL, W-PEST-NP, W-CARB, W-UHERB-MS, W-WSOL-NP		One-time Grab, at beginning of startup, at inflow, outflow, and before/after dividing berm	None	Grab, quarterly, at inflow and outflow**
Water	Mercury +	Total Mercury and Methyl mercury			Grab, quarterly at inflow and outflow	Grab, quarterly at inflow and outflow**
Fish Tissue	Mercury +	Mercury		None. To occur during long-term monitoring only.	None. To occur during long-term monitoring only.	Quarterly, 100 mosquitofish at interior sites and one downstream site; Annually, Five or more Sunfish and 5 or more largemouth bass, at interior sites and one downstream site
Sediment	Mercury +	Total Mercury, Methyl mercury, Acid volatile sulfides, moisture content, TOC	Prior to flooding, soil cores (0-4 cm horizon) at 6 representative interior sites	One-time.		
Sediment	Trace Metals	Al, Cu, Fe, and Zn		None.	soil cores, at end of stabilization, at inflow and outflow	soil cores, Annually, at inflow and outflow**

8.6 ENVIRONMENTAL COMMITMENTS

The U.S. Army Corps of Engineers, its non-Federal sponsor the South Florida Water Management District, and contractors commit to avoiding, minimizing, or mitigating for adverse effects during construction activities by taking the following actions:

1. Employ best management practices with regard to erosion and turbidity control. Prior to construction, the construction team should examine all areas of proposed erosion/turbidity control in the field, and make adjustments to the plan specified in the plan control device as warranted by actual field conditions at the time of construction.

2. The contract specifications will prohibit the contractor from dumping oil, fuel, or hazardous wastes in the work area and will require that the contractor adopt safe and sanitary measures for the disposal of solid wastes. A spill prevention plan will be prepared by the contractor.

3. Demolition debris would be transported to a landfill or otherwise disposed of in accordance with Federal, State, and local requirements. Concrete or paving materials would be disposed of in accordance with Federal, State, and local requirements.

4. Contractor staff would be informed of the potential presence of threatened and endangered species in the project area, the need for precautionary measures and the Endangered Species Act (ESA) prohibition on taking listed species. Construction contractors will be trained and briefed on how to identify the wood storks and bald eagles in the area. The USFWS will be notified upon observation of any stork or eagle nesting activity.

5. The following special measures will be incorporated during project construction to minimize effects to any listed species that may be present: a) Standard protection measures for the Eastern Indigo Snake; b) Management Guidelines for the Bald Eagle in the Southeast Region and Bald Eagle Standard Local Operating Procedures for Endangered Species; and c) Habitat Guidelines for the Woodstork in the Southeast Region.

6. If new electrical lines are constructed near open water to service new pumps, the publication Suggested Practices for Raptor Protection on Power lines: The State of the Art in 1996 shall be consulted for recommended measures to protect bald eagles from electrocution.

Both the FFWCC and the USFWS have been consulted for recommendations on avoidance of impacts to federally listed and state listed species. Both the FFWCC and USFWS will be consulted in the event that colonial or solitary wading bird nests are observed within the construction footprint. In addition, Florida burrowing owls are known to inhabit ruderal areas, such as canal banks and road berms, in the vicinity of the project. Eagle, wood stork, and burrowing owl surveys will be performed prior to the start of construction. If owls are observed within the EAA Storage Reservoir construction footprint, the FFWCC will be consulted for management measures and the contractor may be required to obtain a permit. More information on FFWCC permit requirements and applications can be found on the web at:
http://wld.fwc.state.fl.us/permits/permits.html

If bald eagle nests are encountered on the project footprint, the USFWS's Habitat Management Guidelines for the Bald Eagle in the Southeast Region will be implemented during construction of the EAA Project.

The USFWS will be notified upon locating a dead, injured, or sick wood stork or bald eagle before, during, and after construction of the reservoir.

7. For the manatee, the following Standard Protocols will be used during construction: a) Protocols to Minimize/Avoid Entrapment at structures; b) Protocols for Existing and New Culverts based on the size of culverts; c) the Manatee Blasting Protocol when explosives are required; d) Ground Observer Protocols; as well as the Standard Manatee Construction Conditions. In addition, intake canals and/or structures will include an aluminum grate from the bottom of the structure to approximately 1 ft above high water, with 8 inches of bar spacing, or a similar exclusion feature. The features will be designed for temporary removal in the event of a water emergency.

If barriers are in place at the Lake Okeechobee structures S-351, S-352, and S-354, to prevent manatees from entering the EAA, prior to initial construction of the EAA Project, adverse effects to manatees in the EAA will be minimized, and observer protocols and barriers at individual structures of the EAA Project will be unnecessary.

8. The Corps and the SFWMD agree to maintain an open and cooperative consultation process with the USFWS and FFWCC throughout the design, construction, and operation of this restoration project.

9. A monitoring program will be established to assess mercury levels and other contaminants within the water column, including before drying and upon rehydration of the reservoir. Additional monitoring will be performed at inflow and outflow points. The monitoring program will also include assessing mercury

levels and other persistent contaminants in prey fish (mosquitofish, sunfish, and largemouth bass) within the reservoir, and downstream area. In the event that ecological risks from contaminants to listed species become evident through sampling regimes and monitoring, the USACE will consult with the USFWS to determine if reinitiating consultation in accordance with section 7 of the ESA is necessary.

10. The initial flooding of the reservoir would occur at a rate of 0.5 inch per day until a depth of 6 inches is attained in order to minimize negative impacts to the Eastern indigo snake. The reservoir will also be initially filled at a rate of 1 inch per day from the 6-inch to 12-inch water depth to allow additional time for other terrestrial wildlife to vacate the area.

11. To protect cultural resources conditions stipulated by the SHPO will be followed. Language will be included in construction contract specifications outlining the steps to be taken in the event that undiscovered historical properties are encountered. An informational training session, developed by a professional archaeologist, will be conducted for the contractor's personnel to explain what kinds of archaeological/cultural materials might be encountered during construction of the impoundment, and the steps to be taken in the event these materials are encountered. A professional archaeologist will conduct periodic monitoring of the project area during construction to determine if activities are impacting unanticipated cultural resources.

12. As required under WRDA 2000, water to be reserved for ecosystem restoration was evaluated. This is addressed in Annex G of this report.

13. As likewise required under WRDA 2000, the selected alternative plan has been evaluated in the light of its potential effects on existing legal sources of water and the level of service for flood protection. This is addressed in Annex G of this report.

14. Compliance with the State of Florida's legislative and statutory requirements for approval of CERP projects are also addressed in Annex G.

8.7 VIEWS OF NON-FEDERAL SPONSOR

The Draft EAA Storage Reservoir PIR is the result of analysis and studies dating back over ten years. The C&SF Project resulted in unanticipated adverse impacts to the Everglades Protection Area. The EAA Storage Reservoir project will help moderate the unnatural highs and lows currently experienced in Lake Okeechobee and the Water Conservation Areas. The storage created by this project may provide ecological benefits including reduced nutrient loading to Lake Okeechobee, St. Lucie Estuary, Caloosahatchee Estuary, and the

Everglades Protection Area downstream including Water Conservation Areas 2 and 3 and Everglades National Park.

The goals for this Project are a synthesis of federal, state and local objectives from the Restudy (Central & Southern Florida Project Comprehensive Review Study, 1999) and regional objectives outlined by the Governor's Commission for a Sustainable Florida. The success of this plan is dependent upon its many contributors. The Corps and the SFWMD played key leadership roles. However, without the skilled and persistent support of important contributors from the Department of Environmental Protection, Florida Fish & Wildlife Conservation Commission and U.S. Fish and Wildlife Service, this plan would not be the example of environmental restoration that it surely is.

The EAA Storage Reservoir Project – Phase I is one of the initial 10 projects authorized for implementation in Section 601(b) (2) (C) of WRDA 2000. According to the CERP Master Implementation Sequencing Plan, the project is "Band 1" and is scheduled to be completed and operational by October 2010. In an effort to ensure achievement of this schedule, the SFWMD plans to move forward with detailed design and construction of Compartment A1 of the EAA Storage Reservoir under the State of Florida's Acceler8 Program. It is anticipated that some refinements in design and estimated cost will result from value engineering and other efforts to ensure cost-effectiveness of the final plans and specifications. SFWMD fully intends to collaborate with the U.S. Army Corps of Engineers throughout the detailed design and engineering efforts.

The SFWMD is proud to be a partner with the U.S. Army Corps of Engineers on the EAA Storage Reservoir and is supportive of this vital and exciting project.

SECTION 9
SUMMARY OF COORDINATION AND ENVIRONMENTAL COMPLIANCE

This page intentionally left blank

9.0 SUMMARY OF COORDINATION AND ENVIRONMENTAL COMPLIANCE

9.1 SCOPING AND DRAFT EIS

A Notice of Intent to prepare a Draft Environmental Impact Statement for the EAA Storage Reservoir was published in the Federal Register Volume 67, No. 36 on February 22, 2002. A scoping letter for the EAA Storage Reservoir project was mailed on July 16, 2002, to over 150 recipients, including federal, state, and local agencies; Native American Tribes; private organizations; and, interested parties to solicit their views, comments, and information about resources, study objectives, alternatives, and important features within the Study Area. In addition, the following activities have taken place to involve the public in the planning process:

- Establishment of a website (www.evergladesplan.org) to provide information and communication paths.
- Submission of scoping letter to identified Project stakeholders providing a description of the EAA Storage Reservoir project and identifying points of contact for more information or registering concerns.
- Two public workshops were conducted in Spanish and English at Belle Glade in August 2001 and January 2003.
- A series of PDT meetings (that were open to the public) were held within 50 miles of the Study Area.
- A Project Overview of the EAA Storage Reservoir at the South Florida
- Water Management District Governing Board Meeting in October 2005.
- Miscellaneous public workshops and Water Resource Advisory Committee Meetings in November and December of 2005 on project features.
- Individual project overview meetings with Florida Power and Light and Florida Department of Transportation in 2005.
- Individual project overview meetings with local 298 Districts, agricultural interests and government agencies in November and December 2005.

Information developed from NEPA scoping and outreach processes and other sources were used in project planning to identify problems and opportunities associated with the EAA Storage Reservoir project. Many of the issues are related to the conflict between encroaching human development and the natural environment. Public comments generally supported the projects goals and objectives, but expressed concern over the length of the project schedule. There was public skepticism over the cost effectiveness of storage reservoirs over storing water in Lake Okeechobee or the Water Conservation Areas because of increased evaporation and seepage from the reservoirs. Suggestions were also put forth by the public on investigating alternative approaches to restoring

historic flows and flow-ways. Many of the public comments expressed concern over potential impact on jobs in the EAA.

The Notice of Availability (NOA) of the Draft EIS appeared in the Federal Register Volume 70, No. 198 on October 14, 2005. In addition, the NOA was mailed to interested and affected parties by letter dated September 26, 2005. Comments and responses to those comments have been incorporated into the Revised Draft EIS in Annex H**.**

9.2 COORDINATION WITH EXISTING UTILITIES AND PUBLIC INFRASTRUCTURE [373.1501(5)(E)]

Section 373.1501(5)(e), F.S. requires the SFWMD to "Ensure that implementation of project components is coordinated with existing utilities and public infrastructure and that impacts to and relocation of existing utility and public infrastructure are minimized." The following is a description of this coordination.

9.2.1 Summary of Utilities and Public Infrastructure within the Project Area

Due to its primarily agricultural and rural nature, local public infrastructure in the EAA is very limited. The only public utilities that provide services in the EAA are operated by and generally limited to the city limits of the small cities of Belle Glade, South Bay and Pahokee on the south side of Lake Okeechobee.

The road network in the EAA is also limited and is a mix of municipal, county, state and federal roads, located primarily in the northern portion of the EAA. State Road (SR) 80 is a major east - west road that runs through this area between West Palm Beach and Ft. Myers. Located immediately east of the proposed EAA Reservoir project is US 27 (also known as SR 25). It is the only major north – south road in this area and runs parallel to the west side of the North New River Canal (also known as the L-18 / L-19 / L-20 canal) from the Dade – Broward county area north to South Bay and then west around the southern and western portions of Lake Okeechobee where it then heads north in the state. US 27 is a major north-south route in and out of south Florida for evacuation and commerce purposes. Most of the road network outside the urbanized area and south of Lake Okeechobee is off the major state and federal roads and consists of local, unpaved farm roads.

FPL has several major transmission lines that are located in the northern, eastern and southern portions of the EAA, but none that are located immediately adjacent to or traverse the proposed EAA Reservoir. These transmission lines include the Corbett – Orange River 230 kV transmission line that runs through the northern portion of the EAA, approximately 3 miles north of the Cross and Bolles canals, between the West Palm Beach area and Ft.

Myers; the Andytown – Corbett and Andytown – Martin 500 kV transmission lines that run immediately west of and parallel to the L-6 and L-7 levees and WCA Nos. 1 and 2A; the Levee – Midway 500 kV transmission line that runs one mile west of these two 500 kV transmission lines until it turns south and runs long the west side of the North New River Canal, US 27, and STA ¾ (south of the proposed EAA Reservoirs); and the Andytown – Orange River 500 kV transmission line that runs along the south side of STA ¾ and the Holey Land, north of the L-5 levee, the Palm Beach – Broward County line, and WCA No. 3 from US 27 west to Ft. Myers.

Bell South and four fiber optic communications companies (WilTel Communications, Epik Communications, Broadwing Communications, and Northstar Communications) have a major underground trunk route that runs along the west side of US 27 within the FDOT right-of-way for US 27. There are no cell towers in the immediate vicinity of the EAA Reservoir and canal enhancement projects.

Except for the major electrical transmission lines along the eastern, northern and southern portions of the EAA and the major fiber optic lines along US 27, most of the existing utilities within the EAA study area and the proposed EAA Reservoir and along the North New River, Miami, and Cross and Bolles canals are local distribution type facilities that provide service to existing land uses and/or previous property owners or land uses. Aerial telephone lines are typically co-located on the same poles with electrical distribution lines under a cooperative cost-share arrangement between FPL, Bell South and other telecommunications companies.

There is an existing FPL distribution line along the main east-west drainage canal that provides power to the on-site pump stations that serve the existing farming operations on the EAA Reservoir lands (formerly known as the Talisman Lower Ranch) and previously provided power to the Talisman Sugar Mill that has since been removed. This distribution line will be removed as part of the construction of the EAA Reservoirs project. Other remaining distribution lines in the EAA Reservoirs area will also be removed once the project design has been finalized and it has been determined if any of them need to remain on an interim basis for construction purposes.

In the area between the proposed EAA Reservoir and Lake Okeechobee where there are proposed canal conveyance improvements to the North New River Canal, there are a number of bridges with telephone and communications lines and, in some cases, water and sewer lines suspended from them. Most of these bridges will need to be replaced and the utilities will be relocated as part of the bridge construction projects. In the case of the proposed canal conveyance improvements to the Cross and Bolles canals, the need for relocations of existing

utility facilities that cross or run parallel to the Cross and Bolles canals will depend on the final project design and the location of the additional right-of-way to be acquired to implement the improvements. This includes one FPL 138kV transmission line that crosses the Bolles Canal approximately 2 miles west of US 27.

There is also a Florida East Coast Railroad line that traverses the northern portion of the EAA and includes spurs that provides service to the major sugar mills in the area. They cross the Miami Canal in two locations, one approximately 2 miles north of the Bolles Canal (L-21) and one approximately 3 miles south of the Bolles Canal.

9.2.2 Summary of Coordination Efforts with Existing Utilities and Public Infrastructure

Coordination on the EAA Project has been carried out since the mid-1990's as part of the SFWMD's outreach efforts on the initial Restudy Project, Lake Okeechobee Watershed Management Study, and the development of the Lower East Coast Water Supply Plan. This has included interacting with the municipal and county governments who have jurisdiction in the EAA, the applicable local drainage districts and local utilities, the Treasure Coast Regional Planning Council, the Florida Department of Transportation, Florida Power and Light Co., phone/fiber optic companies and other interested parties.

In addition to the above efforts, the SFWMD has been involved in a number of meetings and other coordination efforts with the District 4 Office of the Florida Department of Transportation regarding scheduled FDOT road projects on US 27 and SR 80, permitting and work coordination requirements, and design considerations to avoid impacts to the integrity of adjacent road bed of US 27 in particular. At this time, FDOT has advised us that they have sufficient right-of-way along US 27 in the vicinity of the proposed EAA reservoir project for any future road improvements that may be required. Based on these efforts to date, it is anticipated that the EAA Reservoir project can be built without adversely impacting FDOTs existing or future facilities in this area.

The SFWMD has also been involved in a number of meetings with FPL regarding the transmission and distribution facilities in the EAA area, including those located in the vicinity of the EAA Reservoir project site and the canal conveyance improvement projects. Discussions regarding the EAA Reservoir project site have focused on the removal of unneeded existing power distribution facilities and future power distribution needs while discussions regarding the canal conveyance improvement projects have focused on possible impacts to existing permitted FPL facilities that cross these canals. No un-resolvable issues have been identified to date.

As a result of the SFWMD's experience during the construction of STA ¾, including the associated bridge construction on US 27, in working with those utilities located on the west side of US 27, it is not anticipated that substantial relocations of utilities will be required to construct this project.

9.3 CIRCULATION OF REVISED DRAFT PIR / EIS

The Revised Draft EIS is anticipated to be released in February 2006. It will be circulated for a minimum of 45 days after noticing in the Federal Register. Copies of the Revised Draft EIS will be mailed to appropriate Federal and State agencies, Native American Tribes, Environmental groups, interested public, as well as persons whom had commented on the draft EIS. Public libraries in the project will be provided copies to maintain in the reference section of the libraries. The Revised Draft EIS will also be posted electronically for web viewing. A public meeting is anticipated to be held in March 2006 to receive comments on the Revised Draft PIR/EIS.

9.4 COMMENTS RECEIVED AND RESPONSES

Several comments were received in response to the Draft EIS. A matrix of the comments and responses, as well as copies of the correspondence, has been provided in Annex H.

9.5 COMPLIANCE WITH ENVIRONMENTAL LAWS, STATUTES AND EXECUTIVE ORDER

The following documents the compliance with applicable environmental laws, statutes, or executive orders (E.O.) and the coordination that has been completed with respect to those laws. Letters of correspondence with appropriate agencies is included in Annex A and Annex H, as applicable. The following descriptions also indicate the status of any on-going or compliance issues.

In as much as construction activities on the EAA Storage Reservoir Acceler8 Project are scheduled to begin in December 2005 in accordance with the schedule for the State of Florida's Acceler8 program, SFWMD will be responsible for obtaining permits issued under the authority of Section 404 of the Federal Clean Water Act. The Acceler8 design, although similar to the PIR, will address impacts, benefits, and compliance with environmental regulations through the Section 404 permitting process with the USACE Regulatory Division. SFWMD will also be responsible for obtaining the Section 401 (Clean Water Act) water quality certification or waiver of water quality certification, as appropriate, from the State of Florida. Typically, water quality certification is obtained through the State of Florida's regulatory program established under the authority of Chapter 373, Florida Statutes. Section 402 (National Pollutant Discharge Elimination System, a.k.a. "NPDES") permits required under the Clean Water

Act will also be required for the construction (non-point source runoff) of project features. This program has been delegated by the U.S. Environmental Protection Agency for implementation to FDEP. NPDES permits for construction of project features under the Acceler8 program prior to Federal approval and authorization of the Selected Plan for the federal EAA Storage Reservoir will be the responsibility of SFWMD. At this time, it is not envisioned that an NPDES permit will be required for the operation of the EAA Storage Reservoir Project, as the project does not involve treatment or the discharge of pollutants.

Depending upon the schedule for obtaining Federal review and approval of the project, USACE will obtain the necessary permits to construct and perform initial operational testing and verification of remaining project features. The cost and schedule for obtaining the necessary permits are included in the project management plan.

9.6 COMPLIANCE WITH FLORIDA STATUTES AND VIEWS OF NON-FEDERAL SPONSOR

SFWMD will be responsible for obtaining permits required by the State of Florida in accordance with Chapters 373 and 403 of the Florida Statutes.

Depending upon the schedule for obtaining Federal review and approval of the project, USACE will obtain the necessary permits to construct and perform initial operational testing and verification of remaining project features. The cost and schedule for obtaining the necessary permits are included in the project management plan.

9.6.1 Clean Air Act of 1972

The existing air quality within South Florida is considered good. Additionally, the region meets current National Ambient Air Quality Standards, a condition requisite for its declaration as a "nonattainment area" (PBC Amb. Mon. Group, 2004). The only potential source of air pollution would be from pump station(s). Pursuant to rule 62-210.300(3)(a)(21)(b), operations staff will be required to determine if stations will be exempt from air permitting or if an air general permit will be required. This project has been and will continue to be coordinated with U.S. Environmental Protection Agency for compliance with Section 309 of the Act. A Title V Source air permit application will be submitted to the Environmental Health and Engineering Section of the County's Department of Health prior to construction.

9.6.2 Clean Water Act of 1972

All State water quality standards will be met. A Section 404 (b)(1) evaluation is included in Annex B of the Revised Draft PIR/EIS. The Water Quality

Certification (WQC) will be met by an NPDES permit. The project is in compliance with this Act.

9.6.3 Coastal Zone Management Act of 1972

The State Clearinghouse provided comments on September 13, 2002, in response to a scoping letter and indicated probable consistency. A federal consistency determination in accordance with 15 CFR 930 Subpart C is included in the Revised Draft PIR/EIS in Annex C. The consistency review, delegated to the State of Florida, will be performed during the coordination of the draft PIR.

9.6.4 National Environmental Policy Act of 1969

A scoping letter for the EAA Storage Reservoir project was mailed on July 16, 2002 to federal, state, and local agencies; Native American Tribes; private organizations; and, interested parties to solicit their views, comments, and information about resources, study objectives, alternatives, and important features within the Study Area. In addition, the following activities have taken place to involve the public in the planning process:

Established a website at http://www.evergladesplan.org/ to provide information and communication paths to the computer-able portion of the population. Two public workshops on the EAA Storage Reservoir project were held in Spanish and English at Belle Glade in August 2001 and January 2003. A series of Project Development Team (PDT) meetings open to attendance and comment by the public. The first PDT meeting was held on March 13, 2001. All PDT meetings were held within 50 miles of the project area.

Information developed from NEPA scoping and outreach processes and other sources were used in project planning to identify problems and opportunities associated with the EAA Storage Reservoir project. Many of the issues are related to the conflict between encroaching human development and the natural environment. Public comments generally supported the projects goals and objectives, but expressed concern over the length of the project schedule. There was public skepticism over the cost effectiveness of storage reservoirs over storing water in Lake Okeechobee or the Water Conservation Areas because of increased evaporation and seepage from the reservoirs. Suggestions were also put forth by the public on investigating alternative approaches to restoring historic flows and flow-ways. Many of the public comments expressed concern over potential impact on jobs in the EAA.

The draft EIS was noticed in the Federal Register in October 2005 and released to the public and agency for review and comment. Comments have been reviewed, incorporated and responded to in preparation of the Revised Draft PIR / EIS. The comment and response matrix is included in Annex H.

The project is in compliance with the National Environmental Policy Act.

9.6.5 Fish and Wildlife Coordination Act of 1958

This project has been coordinated with USFWS and FFWCC. Planning Aid Letters (PALs) have been received from the USFWS on a regular basis since 2002. The USFWS provided recommendations for on-site opportunities to increase fish and wildlife habitat by including deep-water fish refugia within the reservoir, a littoral shelf along the seepage canal, and short-hydroperiod wetland and tree islands within the seepage buffer. The USFWS also provided recommendations for both earthen and roller-compacted concrete (RCC) levees. For earthen levees, the USFWS recommends that the exterior face of the exterior levees be covered with soil to provide some vegetation for habitat and to improve aesthetics. For RCC levees, the USFWS recommends including steps at 1 ft intervals to provide potential resting and feeding habitat for fish and wildlife. The USFWS does not support constructing levees as flat concrete walls, as vertical walls provide no potential habitat for fish and wildlife. They also recommend that soil be placed along the east to southeast (leeward) levee as this placement will minimize soil erosion from wind driven fetch, and that the exterior face of the exterior RCC levees be covered with soil to provide some vegetation for habitat and to improve aesthetics. Regarding reservoir operations, the USFWS recommends minimizing or avoiding drydown to ground surface to reduce potential remobilization of methylmercury or other contaminants into the water column upon reflooding.

The USFWS and the FFWCC have provided Draft Coordination Act Reports (FWCA Report), which are included in this document in Annex A**.** Responses to the FWCA Reports recommendations are also included in Annex A.

A PAL was received form the FFWCC on August 15, 2002. FFWCC concerns included the water quality of the reservoir water and its influence on the nearby stormwater treatment area; impacts on state-listed species; optimizing the reservoir size to benefit Lake Okeechobee, the estuaries, and WCAs 2 and 3; and potential contaminants on agricultural lands. Representatives from both agencies have been involved in the project planning, development and evaluation, with particular interests in effects to fish and wildlife resources and natural wildlife management areas. Coordination continues with USFWS and FFWCC. This project is in full compliance with the Act.

9.6.6 Migratory Bird Treaty Act and Migratory Bird Conservation Act

The project site currently is used for migratory birds (burrowing owls) that could be affected by project activities. A burrowing owl survey will be conducted prior to construction. Construction will not take place during the nesting season in the

event migratory bird nest sites are discovered. Also, with the construction of the reservoir, habitat buffer, and littoral shelves, as well as its location adjacent to natural areas, it is anticipated that migratory birds, especially wading birds, would benefit by additional foraging areas provided by the project. The project is in compliance with these Acts.

9.6.7 Endangered Species Act of 1973

Consultation for Threatened and Endangered Species was initiated with the National Marine Fisheries Service (NOAA), and U.S. Fish and Wildlife Service (USFWS) on July 16, 2002. A list of threatened and endangered species resources and critical habitat was received from each agency. The USACE and USFWS have been in continual coordination to assess potential impacts to the species and identify special requirements for the alternatives. Per agreement between the USACE and USFWS, the Draft PIR/EIS served as the Biological Assessment, and a letter of determination has been sent to the USFWS for their concurrence. The project is not expected to result in unavoidable adverse impacts to most threatened or endangered species, and a determination of either "no effect" or "may affect, not likely to adversely affect" for all but one species. A determination of "may adversely affect" has been made for the Florida panther due to loss of potential habitat. Formal consultation on the panther is currently pending. In December 2005, The USACE received a request for additional information on the Florida Panther. A Biological Assessment of the projects affects to the panther is being prepared to address these concerns. The NMFS concurrence on species within their jurisdiction is still pending as the agency reviews information provided in the Draft PIR/EIS.

9.6.8 Magnuson-Stevens Fishery Conservation and Management Act

Consultation for the EAA Storage Reservoir was initiated in July 2002. The NMFS responded on August 2, 2002, that adverse effects to fish resources and Essential Fish Habitat (EFH) may occur as a result of this project. The NMFS requested an evaluation of impacts to living marine resources, including mangroves, seagrasses, live bottom communities, and the marine/estuarine water column that may be impacted by activities or operations of the project alternatives. The EFH assessment is contained within the body of the Draft PIR/EIS, and has been submitted for coordination. By a letter dated November 17, 2005, the NMFS concurred that implementation of the project would not have adverse impacts to EFH, and may, in fact have beneficial effects to EFH resource. The project is in compliance with the act.

9.6.9 Marine Mammal Protection Act of 1972

The West Indian Manatee does occur within the project area. Incorporation of the safeguards used to protect threatened or endangered species during

construction and operation would protect any marine mammals in the area; therefore, we do not anticipate that the project will result in take as defined by Marine Mammal Protection Act. Manatee protection is managed by the USFWS. The CERP Interagency Manatee Task Force, a subteam of the Manatee Recovery Team headed by the USFWS, recommended in a letter dated April 21, 2005, that due to the risk of manatee entrapment within the EAA canal system resulting in manatee rescues and mortality, the USACE and SFWMD should install manatee barriers at the three main outlet structures (S-351, S-352, and S-354) from Lake Okeechobee into the EAA. Coordination will continue with the USFWS.

9.6.10 Estuary Protection Act of 1968

The project will reduce the freshwater-pulsed flows to the downstream estuaries. Fresh water flows are damaging to the estuaries, as salinity regimes are constantly fluctuating and harming the health of vegetation, fish, and other biota. This project is anticipated to benefit the St. Lucie and Caloosahatchee Estuaries by capturing the freshwater in the storage reservoir; therefore reducing the fresh water flows to the estuaries. This project is in full compliance with the Act.

9.6.11 National Historic Preservation Act of 1966 (Inter Alia)(PL 89-665, the Archeology and Historic Preservation Act (PL 93-291), and executive order 11593)

In accordance with procedures contained in Section 106 of the National Historic Preservation Act of 1966 (Public Law 96-665) as amended in 1992 and 36 C.F.R., Part 800: Protection of Historic Properties; the National Environmental Policy Act of 1969 as amended; Chapter 267, Florida Statutes; Florida's Coastal Management Program, and other implementing state regulations, in order to evaluate the impact and adverse effects or potential adverse effects to historic properties listed, or eligible for listing, to the National Register of Historic Places, a cultural resources assessment has been conducted for the EAA Storage Reservoir Project Area, Palm Beach and Hendry Counties, Florida.

The State Historic Preservation Officer's (SHPO) initial response to the scoping letter (DHR No. 2002-7052) stated that the potential exists for project activities to have an effect on cultural resources listed or eligible for listing in the National Register of Historic Places. A review of the Florida Master Site Files in June 2002, indicated no recorded archaeological or historic sites within Compartment A. A site visit in August 2002 showed extensive agricultural disturbance. Subsequent USACE correspondence with the SHPO, dated September 23, 2002, recommended that a cultural resources survey would not be necessary for Compartment A. The SHPO concurred in a letter (DHR No 2002-09656) dated December 13, 2002, that due to a previous Phase I level investigation in 1996,

and the existing conditions, no cultural resources survey was necessary, subject to the following condition:

A professional archaeologist is on-call and performs periodic monitoring throughout the construction phase of the project

In a subsequent verbal conversation, the SHPO requested a site visit be made of the Miami, North New River, and Bolles/Cross Canals to assess potential impacts to cultural resources from increasing the canal conveyance. USACE correspondence with the SHPO, dated March 19, 2004, recommended that a cultural resources survey would not be necessary for the Bolles/Cross Canal based on the history of land use, canal construction disturbance, and loss of soil in the area. The SHPO requested a professional cultural resources survey in a letter (DHR No 2004-2832) dated May 13, 2004, due to the existence of three recorded historical properties cultural resources, North New River and Bolles/Cross Canals and a prehistoric site, in the vicinity. The canal surveys are currently in progress. USACE correspondence with the SHPO, dated 3 May 2005, recommended a cultural resource survey be conducted of the North New River Canal and known prehistoric sites in the vicinity of the junction of the Canal and Lake Okeechobee. The SHPO concurred with this recommendation in a letter (DHR No. 2005-4654) dated 19 May 2005. A contract for the cultural resources survey should be awarded early in 2006. Coordination of the results is in progress.

9.6.12 Resource Conservation and Recovery Act of 1976; Toxic Substances Control Act of 1976

Several site visits were conducted to locations identified in the HTRW database over the past few years. The HTRW database review of existing conditions found the potential project site to be free of hazardous and toxic materials and waste. However, the database search did reveal that the road adjacent to a possible site for the proposed 60,000-acre (24,281 HA) storage site did have a toxic release to the north of the northernmost 20,000-acre (8,094 HA) storage cell. This spill poses a low risk to the site.

According to the EAA Storage Reservoir Environmental Summary Document (URS, 2003), over 19 environmental engineering companies and consultants have conducted some type of environmental assessment and/or corrective actions on the tracts of the subject area beginning in 1989, with work projected until at least 2007. Phase I, Phase II, and Ecological Risk Assessments have been conducted over the 18-year time frame.

Assessments covered 34 individual tracts of land and two wildlife management areas. Section A1 (C1) makes up approximately one-third of the assessed area. The Phase I and II Environmental Site Assessments (ESAs) were conducted at

32 of the 34 tracts. The Phase I ESAs identified 193 areas of concern ranging from maintenance areas, to mix and load and staging areas chemical storage buildings, to petroleum storage tanks, pump station, and refueling areas to former airstrips. Three of the tracts within the project area, the Rotenberger Wildlife Management Area, the Holey Land Wildlife Management Area and the Talisman South Ranch #100-1002 have not been formally evaluated.

Of the 193 areas identified, a total of 59 areas warranted no further actions after conducting the Phase II ESA. Additional assessments and/or corrective actions beyond the Phase II ESA were conducted at 117 areas. The data from these additional assessment/corrective action activities were submitted to the FDEP. At tracts where ERAs were conducted, the data was submitted to the FWS. No Further Actions (NFA), Site Rehabilitation Completion Orders (SRCO), or concurrences were issued to each of the 117 areas by these two regulatory agencies. Only 17 areas remain out of the 193 areas identified that will require additional assessments, are being completed, or will require corrective actions. None of these remaining areas lie within the project area with the exception of the Woerner Farm #3 parcel. Recent post-remediation testing of the Woerner Farm #3 property located in the northernmost portion of the Cell #1 footprint yielded elevated levels of toxaphene. The Fish and Wildlife Service (FWS) has performed an environmental risk assessment and determined that toxaphene, at possible action levels, is widely distributed I the shallow soil layer within the Woerner Farm #3 area. However, no final determination has been made and the FWS is currently coordinating with the SFWMD to develop a plan of action for final closure of the site.

Sediments in the primary canals (Miami, North New River, Cross, and Bolles) have been sampled and analyzed in conjunction with the SFWMD DBHYDRO database.

The data indicates that the sediments contain persistent pesticides – DDT and its degradation products being the most prevalent. However, the sum of DDT and DDT products in recent samples reaches one- to five-tenths of a milligram per kilogram of sediment [0.1 mg/kg (ppb)– 0.5 mg/kg (ppb)], which is below the State's action levels (3300 ppb—Chapter 62-777, F.A.C Table 2: Soil Clean-up Target Levels) and SQAGs (Sediment Quality Assessment Goals—1.19 ppb). Sampling of the sediment will occur during construction. Proper handling and disposal of contaminated sediments will consist of: 1) measuring levels of pesticides in sediments, 2) avoiding disturbance of contaminated sediments where possible, and, 3) isolating removed contaminated sediments and placement of those sediments in a manner so as to inhibit the migration of contaminants. Given adherence to the above specifications, this project is in compliance with the Acts.

9.6.13 Farmland Protection Policy Act of 1981

This project has been coordinated with the Natural Resources Conservation Service (NRCS) in accordance with the Act. The determination that unique farmland would be taken out of production by implementation of this project has been made by the NRCS in a letter dated May 6, 2005. Coordination with the NRCS is in progress.

9.6.14 E.O. 11988, Flood Plain Management

The project has been evaluated in accordance with this Executive Order. This project is in compliance.

9.6.15 E.O. 11990, Protection of Wetlands

Wetlands of marginal quality on-site will be eliminated with the construction of reservoir. However, the reservoir design will include wetland features, such as a vegetated habitat buffer, littoral shelves, and deep-water refugia. In addition, the STA feature will provide additional wetland habitat. Justification for the benefits to wetlands in the region of the project verses the removal of on-site wetlands is documented in several sections of the PIR dealing with the analysis of benefits to the region should the EAA Reservoir is built and functional. The philosophy of CERP is that the individual components, or projects, of CERP to restore Everglades' wetland function and habitat compensate for the loss of on-site wetlands. The fresh water wetlands within project lands are degraded and provide minimal functional habitat for fish and wildlife. The loss of function resulting from constructing a reservoir at this location would be offset by improvements to fish and wildlife habitat in the Lake Okeechobee, WCA-2 and 3, and the St. Lucie and Caloosahatchee Estuaries. Additional features, such as deep water refugia, littoral shelves, and the ecological buffer zone are meant to provide opportunities for fish and wildlife utilization and replace areas of functional wetlands. Overall, the storage reservoir is anticipated to benefit the adjacent wetland systems. This project is in compliance with the goals of this Executive Order.

9.6.16 E.O. 12898, Environmental Justice

Executive Order 12898 requires the Federal Government to achieve environmental justice by identifying and addressing disproportionately high adverse effects of its activities on minority or low-income populations, and by involving potentially affected minorities in the public coordination process. This project would not result in adverse human health or environmental effects. An

assessment is included in Section 7 of the report. The project is in compliance with the Executive Order.

9.6.17 E.O. 13112, Invasive Species

The project site has a 31,500-acre footprint. Much of the vegetation is sugarcane, which will be removed within the immediate footprint as a consequence of construction of the impoundment. Construction equipment will use standard measures to avoid the spread of invasive species. The tree islands of the habitat buffer will be planted with native trees to reduce the potential for exotic invasive species. In addition, project benefits include restoring the natural hydrology to two water conservation areas. Restored hydroperiods, and the restoration of more natural sheet flow are changes that will benefit native vegetation to the detriment of exotic species. This project will not authorize, fund, or carry out any action that might spread or introduce invasive species. This project would also implement an exotic / invasive vegetation maintenance program on-site. Therefore, this project will comply with the goals of this Executive Order.

SECTION 10
RECOMMENDATIONS

This page intentionally left blank

10.0 RECOMMENDATIONS

I am recommending a plan that is designed to capture, store and redistribute fresh water previously lost to tide and to regulate the quality, quantity, timing and distribution of water flows, that is an integral part of the CERP. The CERP will play an important role in reversing the environmental impacts that have occurred for the past fifty years as a result of the existing C&SF Flood Control System. The lack of storage in the Everglades system, particularly during wet periods, has led to ecological damage to Lake Okeechobee's littoral zone and damaging regulatory releases to the estuaries and the WCAs. Conversely, during dry periods, this lack of storage results in water supply shortages for both the human and natural environment. The overall objectives of the EAA Storage Reservoir project are to improve timing of environmental deliveries to the WCAs including reducing damaging flood releases from the EAA to the WCAs, reduce Lake Okeechobee regulatory releases to estuaries, and meet supplemental agricultural irrigation demands. The Project includes one of the ten CERP projects conditionally authorized by Congress in section 601(b)(2)(C)(ii) of the WRDA of 2000, Public Law 106-541.

I find that the EAA Storage Reservoir Project, located in western Palm Beach County, is an integral part of CERP. The Project will have two Compartments with a total storage capacity of up to 360,000 acre-feet. Environmental restoration is achieved by improving the quality, quantity, timing, and distribution of water within the Everglades, providing wetlands, aquatic deep water refugia, littoral zones, and terrestrial habitat around and within the reservoirs. Supplemental agricultural water supply within the EAA during dry periods is currently met by deliveries from Lake Okeechobee. Additional water storage within the EAA would lesson its dependency on the lake for irrigation water. Flood damage reduction, while not a primary project objective, is attained by increasing canal conveyance capacity in the canals and by providing storage capacity in the surface impoundments. To ensure that water that is to be delivered to the WCAs and ENP meets water quality requirements, a conceptual stormwater treatment area is included in the plan. Approximately 1,495 acres of land already owned by the State of Florida and the SFWMD adjacent to and in the southwest corner of the reservoir have been identified as the likely site for the STA. Additional analysis will be conducted prior to the Final PIR and during the detailed engineering and design phase of the project to refine the design, cost, and operations of this STA. Sizing and optimization of the proposed STA may include converting a portion of Cell 2 to a STA as well.

Therefore, I recommend that the EAA Storage Reservoir Project as described in Section 6 of this report be authorized with such modifications thereof as in the discretion of the Chief of Engineers, may be advisable, for construction. The total estimated project first cost is $912,895,089 with an estimated Federal first

cost of $456,447,545 and an estimated non-Federal first cost of $456,447,545. The estimated total annual cost of operation, maintenance, repair, rehabilitation and replacement is $2,413,982 with an estimated Federal annual cost of $1,206,991 and an estimated non-Federal cost of $1,206,991.

The above recommendations are made with the provision that the Non-Federal Sponsor and the Secretary of the Army shall enter into a binding agreement defining the terms and conditions of cooperation for implementing the Project, and that the Non-Federal Sponsor agrees to perform the following items of local cooperation:

a) Provide 50 percent of total project costs consistent with the provisions of Section 601(e) of the Water Resources Development Act of 2000.
b) Provide all lands, easements, and rights-of-way, and perform or assure the performance of all relocations determined necessary for the construction, operation, and maintenance of the project.
c) Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project.
d) Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land that the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.
e) Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project in a manner compatible with the project's authorized purposes an in accordance with applicable Federal and State laws and specific directions prescribed in the OMRR&R manuals and any subsequent amendments thereto. Cost sharing for OMRR&R will be in accordance with Section 601 of WRDA 2000:

   "(e) COST SHARING.-
   (4) OPERATION AND MAINTENANCE.
   - Notwithstanding section 528(e)(3) of the Water Resources Development Act of 1996 (110 Stat. 3770), the Non-Federal Sponsor shall be responsible for 50 percent of the cost of operation, maintenance, repair, replacements and rehabilitation activities authorized under this section…"
f) The non-Federal Sponsor shall operate, maintain, repair, replace and rehabilitate the recreational features of the project and shall be responsible for 100 percent of the cost.

g) Unless otherwise provided for in the statutory authorization for this project, comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the WRDA of 1986, Public Law 99-662, as amended which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the Non-Federal Sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.
h) Hold and save the Government free from all damages arising for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.
i) Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.
j) Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the Non-Federal Sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.
k) Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on or under lands, easements, or right-of-ways that the Government determines necessary for the construction, operation, or maintenance.
l) As between the Government and the Non-Federal sponsor, the Non-Federal Sponsor shall be considered the operator of the Project for the purposes of CERCLA liability. To the maximum extent practicable, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the Project in a manner that will not cause liability to arise under CERCLA.
m) Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstruction or encroachments) which might reduce ecosystem restoration benefits, hinder operation and maintenance, or interfere with the projects proper function, such that as any new developments on project lands or the addition of facilities which would degrade the benefits of the project.
n) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law

91-646, as amended by the title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

o) Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army.";.

p) Provide 50 percent of that portion of total cultural resource preservation mitigation and data recovery costs attributable to the project that are in excess of one percent of the total amount authorized to be appropriated for the project.

q) Do not use Federal funds to meet the Non-Federal Sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized.

I recommend that Congress provide authority for the Non-Federal Sponsor to receive credit for planning, engineering, design and construction performed by it, or under contract by it, towards the implementation of the EAA Storage Reservoirs Project before project cooperation agreement execution if the Secretary of the Army determines that the work performed was for a reasonable cost, necessary and integral to the Project and was implemented to appropriate design and construction standards.

A. If the lands, easements and rights-of-way were acquired prior to execution of the project cooperation agreement, the creditable value shall be their purchase price, subject to a determination of reasonableness where appropriate, together with their reasonable and necessary incidental costs of acquisition.

B. The value of lands, easements, or rights-of-way acquired by the Non-Federal Sponsor after the effective date of the Project Cooperation Agreement executed for this Project shall be the fair market value of such real property interests at the time the interests are acquired, together with the reasonable and necessary incidental costs of acquisition

The Non-Federal Sponsor is exploring alternative project delivery methods to expedite implementation of portions of the EAA Storage Reservoir Project through the State's Acceler8 Program. Such delivery methods may include a construction management at risk contract or a public-private partnership in which the Non-Federal Sponsor contracts with a private or not-for-profit entity

for services that may include designing, building, operating or financing these components. Expedited implementation may involve the Non-Federal Sponsor initiating construction activities prior to executing a Project Cooperation Agreement (PCA). Expedited implementation of the EAA Storage Reservoir Project is in the best interest of the Federal Government because it will provide early restoration benefits, potential cost savings and reduced cash flow demands. Therefore, I recommend that the Non-Federal Sponsor be credited for expenditures for work on the EAA Storage Reservoirs Project completed in advance of executing a PCA with the Corps and for services provided under a construction management at risk contract or public-private partnership. Credit for such work is subject to the Secretary of the Army determining that the work is integral to the authorized CERP Project and that the construction is consistent with applicable Corps construction standards.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Robert M. Carpenter
Colonel, Corps of Engineers
District Engineer

This page intentionally left blank

SECTION 11
GLOSSARY OF TERMS AND ACRONYMS

This page intentionally left blank

11.0 GLOSSARY OF TERMS AND ACRONYMS

11.1 GLOSSARY OF TERMS

A

Acre-foot— The quantity of water required to cover 1 acre to a depth of 1 foot. Equal to 43,560 cubic feet (1,233.5 cubic meters).

Affected environment— Existing biological, physical, social, and economic conditions of an area subject to change, both directly and indirectly, as a result of a proposed human action.

Air quality— Measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.

Aquatic— Living or growing in or on the water.

Aquifer— An underground geologic formation in which water can be stored.

B

Base— The "base case" simulations estimate what the regional hydrologic conditions would have been during the 1965 – 1995 rainfall sequence if the facilities, operational policies and water use levels were in place that are most consistent with those of the 1990 existing conditions or those projected for 2010 conditions. Best Management Practices for the EAA and the Everglades Construction Project are assumed to be in place for the 2010 simulations. The comparison of the base case and NSM outputs can also be used as a preliminary technique for identifying areas where restoration may be needed.

Benthic— Bottom of rivers, lakes, or oceans; organisms that live on the bottom of water bodies.

Best Management Practice— (BMP) The best available technology or process that is practical and achieves the desired goal or objective.

Biodiversity— The number of different species inhabiting a specific area or region.

Biological opinion— Document issued under the authority of the Endangered Species Act stating the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service (NMFS) finding as to whether a Federal action is likely to jeopardize the continued existence of a threatened or endangered species or

result in the destruction or adverse modification of critical habitat. This document may include:

Critical habitat— A description of the specific areas with physical or biological features essential to the conservation of a listed species and which may require special management considerations or protection. These areas have been legally designated via Federal Register notices.

Jeopardy opinion— The U.S. Fish and Wildlife Service or NMFS opinion that an action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. The finding includes reasonable and prudent alternatives, if any.

No jeopardy opinion— U.S. Fish and Wildlife Service or NMFS finding that an action is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat.

C

Candidate species— Plant or animal species not yet officially listed as threatened or endangered, but which is undergoing status review by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.

Channel— Natural or artificial watercourse, with a definite bed and banks to confine and conduct continuously or periodically flowing water.

Conveyance capacity— The rate at which water can be transported by a canal, aqueduct, or ditch. In this document, conveyance capacity is generally measured in cubic feet per second (cfs).

Cubic feet per second— A measure of the volume rate of water movement. As a rate of streamflow, a cubic foot of water passing a reference section in 1 second of time. One cubic foot per second equals 0.0283 meter /second (7.48 gallons per minute). One cubic foot per second flowing for 24 hours produces approximately 2 acre-feet.

D

Dissolved oxygen (D.O.) — A commonly employed measure of water quality.

Dry Season— Hydrologically, for south Florida, the months associated with a lower incident of rainfall, November through April.

E

Ecosystem— A functional group of animal and plant species that operate in a unique setting that is mostly self-contained.

Endangered species— Any species or subspecies of bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion of its range. Federally endangered species are officially designated by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service and published in the Federal Register.

Enhancement— Measures which develop or improve the quality or quantity of existing conditions or resources beyond a condition or level that would have occurred without an action; i.e., beyond compensation.

Environmental consequences— The impacts to the Affected Environment that are expected from implementation of a given alternative.

Environmental Impact Statement (EIS) — An analysis required by the National Environmental Policy Act for all major federal actions, which evaluates the environmental risks of alternative actions.

Estuary— A water passage where the tide meets a river current; an arm of the sea at the lower end of a river.

Eutrophic— Referring to a body of water which is naturally or artificially enriched in dissolved nutrients, and often shallow with a seasonal deficiency in dissolved oxygen due to high primary production.

Evaporation— The change of a substance from the solid or liquid phase to the gaseous (vapor) phase.

Evapotranspiration (ET) — Evapotranspiration is part of the hydrologic cycle that is a combination of evaporation and transpiration. Solar energy induces evaporation, causing water vapor to condense and fall as precipitation. A portion of this precipitation seeps into the ground and is consumed by plants. It is then recycled back into the atmosphere in the form of transpiration.

Exotic species— Introduced species not native to the place where they are found.

F

Flow— The volume of water passing a given point per unit of time.

Instream flow requirements— Amount of water flowing through a stream course needed to sustain instream values.

Minimum flow— Lowest flow in a specified period of time.

Peak flow— Maximum instantaneous flow in a specified period of time.

G

H

Habitat— Area where a plant or animal lives.

Heterogeneity— Unlike, dissimilar, not uniform

Hydrologic response— An observed decrease or increase of water in a particular area.

Hydroperiod— For non-tidal wetlands, the average annual duration of flooding is called the hydroperiod, which is based only on the presence of surface water and not its depth.

Hydropattern— A less frequently used but nonetheless important term that refers to depth as well as hydroperiod is hydropattern. Hydropatterns are best understood by a graphic depiction of water level (above as well as below the ground) through annual cycles.

I

Indicator species— Organism, species, or community which indicates presence of certain environmental conditions.

Irrigation water— Water made available from the project which is used primarily in the production of agricultural crops or livestock, including domestic use incidental thereto, and the watering of livestock. Irrigation water also includes water used for domestic uses such as the watering of landscaping or pasture for animals (e.g., horses) which are kept for personal enjoyment.

J

Juvenile— Young fish older than 1 year but not having reached reproductive age.

K

L

Limnology— Scientific study of the physical, chemical and biological characteristics of freshwater including lakes, streams, and ponds.

Littoral zone— The shore of land surrounding a water body that is characterized by periodic inundation or partial saturation by water level. Typically defined by species of vegetation found.

M

Marl— Soil comprised of clays, carbonates and shell remains.

Marsh— An area of low-lying wetland.

Mercury— Heavy metal that is toxic to most organisms when converted into a byproduct of inorganic-organic reaction. Distributed into the environment mostly as residual particles from industrial processes.

Mitigation— One or all of the following: (1) Avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating an impact over time by preservation and maintenance operations during the life of an action; and (5) compensating for an impact by replacing or providing substitute resources or environments.

Model— A tool used to mathematically represent a process which could be based upon empirical or mathematical functions. Models can be computer programs, spreadsheets, or statistical analyses.

Muck lands— Fertile soil containing putrid vegetative matter.

N

No Action Alternative— The planning process by which the action agency decides to not carry forth any planned action to alter existing conditions

O

Oxygen demand— The biological or chemical demand of dissolved oxygen in water. Required by biological processes for respiration.

P

Peat— Soil rich in humus or organic (exerts of oxygen demand) and is highly porous.

Phosphorus— Element or nutrient required for energy production in living organisms. Distributed into the environment mostly as phosphates by agricultural runoff (fertilizer) and life cycles. Frequently the limiting factor for growth of microbes and plants.

Planning Area— The entire Central and Southern Florida Project.

Preferred alternative— The alternative plan which is preferred by the action agency, sponsor, or other entity, among the array of alternatives being considered in the NEPA document.

Proposed action— Plan that a Federal agency intends to implement or undertake and which is the subject of an environmental analysis. Usually, but not always, the proposed action is the agency's preferred alternative for a project. The proposed action and all reasonable alternatives are evaluated against the no action alternative.

Project Area— The entire EAA basin.

Project Footprint— Includes those lands upon which the project features are constructed.

Public involvement— Process of obtaining citizen input into each stage of the development of planning documents. Required as a major input into any EIS.

Q

R

Release— For this report, release is an intentional opening up of water control structures to allow stored water to flow out for 2 reasons. First, to lower water

stage to acceptable levels. Second, to make available water for water supply demand (e.g., ecological, agricultural, or urban).

Reservoir— Artificially impounded body of water.

S

Scoping— The process of defining the scope of a study, primarily with respect to the issues, geographic area, and alternatives to be considered. The term is typically used in association with environmental documents prepared under the National Environmental Policy Act.

Seepage— Water that escapes control through levees, canals or other holding or conveyance systems.

Slough— A depression associated with swamps and marshlands as part of a bayou, inlet or backwater.

Spillway— Overflow structure of a dam.

Stream— Natural water course.

Subsidence— A local mass movement that principally involves the gradual downward settling or sinking of the earth's surface with little or no horizontal motion. It may be due to natural geologic processes or mass activity such as removal of subsurface solids, liquids, or gases, ground water extraction, and wetting of some types of moisture-deficient loose or porous deposits.

T

Threatened species— Legal status afforded to plant or animal species that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range, as determined by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.

U

V

W

Wetland— A zone periodically or continuously submerged or having high soil moisture, which has aquatic and/or riparian vegetation components, and is

maintained by water supplies significantly in excess of those otherwise available through local precipitation.

Wet Season— Hydrologically, for south Florida the months associated with a higher than average incident of rainfall, May through October.

Wildlife habitat— An area that provides a water supply and vegetative habitat for wildlife.

X

Y

Yellow Book – See "Restudy"

Z

11.2 ACRONYMS

A

AFB	Alternative Formulation Briefing
AID	Acme Improvement District
AIWW	Atlantic Intracoastal Waterway
AQI	Air Quality Index
ASA(CW)	Assistant Secretary of the Army for Civil Works
ASR	Aquifer Storage and Recovery
AST	Aboveground Storage Tanks

B

BC	Benefit-Cost
BCR	Benefit Cost Ratio
bls	Below Land Surface
BMP	Best Management Practice
bsl	Below Sea Level
BOD	Biochemical Oxygen Demand
BY	Budget Year

C

C	Canal
C&SF	Central and Southern Florida
CAR	Coordination Act Report
CBRA	Coastal Barrier Resources Act (COBRA)
CCMP	Comprehensive Conservation and Management Plan
CE/ICA	Cost Effectiveness/Incremental Coat Analysis
CEM	Conceptual Ecological Models
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
CERP	Comprehensive Everglades Restoration Plan
CESAJ	U.S. Army Corps of Engineers, Jacksonville District
CFS	Cubic Feet Per Second (cfs)
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
Co.	County
COD	Chemical Oxygen Demand
Corps	U.S. Army Corps of Engineers
CPM	Critical Path Method
C&SF	Central and Southern Florida Project

CWA	Clean Water Act (of 1977)
CY	Cubic yard
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act

D

DA	Department of the Army
DAR	Defense Acquisition Regulations
dB	Decibels
DCE	Design Construction Evaluation
DCT	Design Coordination Team
DE	District Engineer
DEIS	Draft Environmental Impact Statement
DEP	Department of Environmental Protection [Florida – FDEP]
DO	Dissolved Oxygen [D.O.]
DoD	Department of Defense
DOD	Dissolved Oxygen Demand
DOE	Department of Energy
DOI	Department of the Interior
DOJ	Department of Justice
DOQQ	Digital Oration Quarter Quadrangle
DOT	Department of Transportation
DPR	Detailed Project Report
DPS	Detailed Project Study

E

EAA	Everglades Agricultural Area
EA	Environmental Assessment
E&D	Engineering and Design
EFA	Everglades Forever Act
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ENP	Everglades National Park
EO	Executive Order
EPA	Environmental Protection Agency
EPGM	Everglades Phosphorus Gradient Model
ER	Engineering Regulation
ESA	Endangered Species Act
ET	Evapotranspiration
EWMA	Everglades-Francis S. Taylor Wildlife Management Area

F

°F	Degrees Fahrenheit
FAC	Florida Administrative Code
FAQs	Frequently Asked Questions
FDEP	Florida Department of Environmental Protection
FC	Flood Control
FCSA	Feasibility Cost Sharing Agreement
FDEP	Florida Department of Environmental Protection
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFWCC	Florida Fish and Wildlife Conservation Commission
FIFR	Final Integrated Feasibility Report
FIFRA	Federal Insecticide, Fungicide and Rodenticide ACT
FLUCCS	Florida Land Use / Land Cover Classification System
FMSF	Florida Master Site File
FNAI	Florida Natural Areas Inventory
FONSI	Finding of No Significant Impact
FPFWCD	Fort Pierce Farm Water Control District
FPL	Florida Power & Light
fps	Feet Per Second
F.S.	Florida Statutes
FSM	Feasibility Scoping Meeting
FWC	Florida Fish and Wildlife Conservation Commission
FWCA	Fish and Wildlife Coordination Act
FY	Fiscal Year

G

GIS	Geographical Information Systems
GM	Guidance Memorandum
GMS	Groundwater Modeling System
GSA	General Services Administration

H

H&H	Hydraulics and Hydrology
HHD	Herbert Hoover Dike
Hg	Mercury
HTRW	Hazardous, Toxic, Radioactive Wastes
HQ	Headquarters

I

I-75	Interstate 75
IAP	Lake Okeechobee Interim Project Plan
ICA	Incremental Cost Analysis
IM	Information Management
IRL	Indian River Lagoon
ITR	Independent Technical Review
ITRT	Independent Technical Review Team
IWR	Institute for Water Resources

J

K

L

L	Levee
LEC	Lower East Coast of Florida
LERRDS	Lands, Easements, Right-of-ways, Relocation, and Disposal
LNWR	Loxahatchee National Wildlife Refuge
LOWQM	Lake Okeechobee Water Quality Model

M

MAD	Multi-agency Design Team
MAP	Monitoring and Assessment Plan
MCACES	Microcomputer Aided Cost Engineering System
MFL	Minimum Flow and Levels
mgd	Million Gallons Per Day
mg/l	Milligrams Per Liter
MLW	Mean Low Water
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPMP	Master Program Management Plan
msl	Mean Sea Level
MSRP	Multi-Species Recovery Plan
MSSW	Management and Storage of Surface Water

N

NAAQS	National Ambient Air Quality Standard
NED	National Economic Development
NEPA	National Environmental Policy Act

NER	National Ecosystem Restoration
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSID	North Springs Improvement District
NSM	Natural Systems Model
NWI	National Wetlands Inventory

O

OASA (CW)	Office of the Assistant Secretary of the Army for Civil Works
OMMR	Operation, Maintenance, Repair, Rehabilitation, Replacement
O&M	Operations and Maintenance
OMRR&R	Operation, Maintenance, Repair, Replacement, and Rehabilitation
OFW	Outstanding Florida Water
OMB	Office of Management and Budget
OPE	Other Program Element

P

P	Phosphorus
PCB	Polychlorinated Biphenyls
P&G	Principles and Guidelines
Pb	Lead
PCA	Project Cooperation Agreement
PDT	Project Delivery Team
PE	Professional Engineer
PE&D	Planning, Engineering and Design
PEIS	Programmatic Environmental Impact Statement
PIR	Project Implementation Report
PM	Performance Measures
PMP	Project Management Plan
ppb	Parts Per Billion
ppt	Parts Per Thousand
PRB	Project/Program Review Board

Q

Q&A	Question and Answer
QA	Quality Assurance

QAQC	Quality Assurance and Quality Control
QC	Quality Control
QM	Quality Management

R

RCC	Roller Compacted Concrete
RCRA	Resource Conservation Recovery Act
RED	Regional Economic Development
RECOVER	Restoration Coordination and Verification
RED	Regional Economic Development Effects
Restudy	C&SF Project Comprehensive Review Study
RET	Regional Evaluation Team [sub-team of RECOVER]
RIMS	Regional Input-Output Modeling System
ROD	Record of Decision
ROW	Right of Way

S

S	Structure
SAD	South Atlantic Division
SAV	Submerged Aquatic Vegetation
SAS	Surficial Aquifer System
SCORP	Florida State Comprehensive Outdoor Recreation Plan
SFERTF	South Florida Ecosystem Restoration Task Force
SFWMD	South Florida Water Management District
SFWMM	South Florida Water Management Model
SHPO	State Historic Preservation Officer
SOP	Standard Operating Procedure
SR	State Road or State Route
STA	Stormwater Treatment Area

T

TMDL	Total Minimum Daily Load
TP	Total Phosphorus

U

US	United States
USACE	United States Army Corps of Engineers (also known as the Corps)
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey

V

VE	Value Engineering

W

WCA	Water Conservation Area
WCDSS	Water Control Decision Support System
WMA	Wildlife Management Area
WPA	Water Preserve Areas
WQ	Water Quality
WRAC	Water Resources Advisory Commission
WRAP	Wetland Rapid Assessment Procedure
WRDA	Water Resources Development Act
WS	Water Supply
WSE	Water Supply and Environment alternative

X

Y

Z

2

22AZE	Lake regulation schedule alternative

This page intentionally left blank

SECTION 12
LIST OF REPORT PREPARERS

This page intentionally left blank

12.0 PREPARERS OF THE PIR

Preparer	Agency	Discipline/Expertise	Contribution
Ahmed, Shabbir	U.S. Army Corps of Engineers (USACE)	Engineer/ Hydrology	Groundwater Modeling
Alger, Yvette	Florida Fish and Wildlife Conservation Commission	Fish and Wildlife Biologist, Ecologist	Environmental Effects
Brown, Chris	USACE	Engineer /Geotech	Groundwater Modeling
Brown, Ed	USACE	Engineer/ Environmental	Water Quality
Bush, Eric	USACE	Planner	Project Assurances & Savings Clause Evaluations
Cintron, Barbara	USACE	Planner/Environmental	Environmental Effects
Clifton, Ray	USACE	Engineer/Cost	Cost Estimates
Coughanour, Susan	SFWMD	Planner/Environmental	Plan Formulation
Cushing, Janet	USACE	Planner/Environmental	Environmental Effects
Dudek, Paul	USACE	Engineer/ Mechanical	Mechanical Design
Fellows, Charles	Water & Air Research, Inc. (WAR)	Environmental	Environmental Effects
Foerster, Cathleen	WAR	Environmental	Environmental Effects
Fury, Cindy Brashear	U.S. Fish and Wildlife Service (FWS)	Fish and Wildlife Biologist	Environmental Effects
Graham, Chris	USACE	Planner/Economist	Economic Costs
Hadley, Lori	USACE	Engineer/ Hydrology	Wave Run-up and Overtopping Analysis
Heaney, James	University of Florida	Environmental	Environmental Effects
Irvin, Cynthia	USACE	Planner	Plan Formulation
Itani, Samir	USACE	Engineer/ Geotech	Embankment Design
Kinser, William	WAR	Environmental	Environmental Effects
Knight, Robert	Wetland Solutions, Inc.	Environmental	Environmental Effects
Knight, Scott	University of Florida	Environmental	Environmental Effects
Komlos, Shawn	USACE	Planner/Environmental	Project Assurances & Savings Clause Evaluations
Krenz, Jerry	South Florida Water Management District (SFWMD)	Planner	Planning
Lizarribar, Jose	USACE	Engineer/Civil	Civil and Site Design
Madina, Moises	USACE	Engineer/Structural	Structural Design
McLean, Stuart	USACE	Biologist, Planning Technical Lead	Plan Formulation
McMunigal, Callie	FWS	Biologist	Project Assurances & Savings Clause Evaluations
Meyer, Miles	FWS	Sr. Fish and Wildlife Biologist	Environmental Effects
Mills, Brenda	SFWMD	Planner	Project Assurances & Savings Clause Evaluations

Morgan, John	SFWMD	Planning	Legislative and Statutory Requirement Annex
Morrison, Matthew	SFWMD	Project Manager	Plan Formulation
Mosura-Bliss, Lynn	WAR	Environmental	Environmental Effects
Needle, Jeff	SFWMD	Engineer	Engineering Appendix
Nelson, Donald	USACE	Assistant District Counsel, Office of Counsel Real Estate	Real Estate Appendix and Land Evaluations
Nguyen, Steve	USACE	Engineer/Hydraulic Design	Hydrologic Engineering
Nieman, Donald	USACE	Engineer/Technical Lead	Management
Pinion, Timothy	FWS	Fish and Wildlife Biologist	Environmental Effects
Pugh, David	USACE	Archaeologist	Archaeology Survey
Raulerson, Stephanie	USACE	Engineer/ Hydrology	Operations Plan
Reed, Russell	USACE	Planning	Plan Formulation
Reisinger, Dan	University of Florida	Environmental	Environmental Effects
Smith, Pauline	USACE	Project Manager	Management
Sutterfield, Steve	USACE	Planning	Plan Formulation
Switanik, Milton	USACE	Engineer/ Geotech	Geologist
Sylvester, Phil	USACE	Engineer/ Hydrology	Hydrologic Modeling
Trauger, Brent	USACE	Engineer/Structural	Dam Safety
Toups, Joseph	USACE	Engineer/Structural	Structural Design
Tucker, Rob	USACE	Engineer/Hydrology	Wave Run-up and Overtopping Analysis
Waldeck, Shawn	SFWMD	Engineer	Management
Weiss, Rebecca	USACE	Biologist/Environmental Planning	Environmental Effects
White, Mark	USACE	Planner/Environmental	Environmental Effects
Zegel, William	WAR	Environmental	Environmental Effects

SECTION 13
REFERENCES

This page intentionally left blank

13.0 REFERENCES

Atkeson, T. and P. Parks. 2002. Mercury monitoring, research and environmental assessment. In: SFWMD, 2002 Everglades Consolidated Report, South Florida Water Management District; West Palm Beach, Florida, Chapter 2B.

Bull, L.A., D.D. Fox, D.W. Brown, L.J. Davis, S.J. Miller, and J.G. Wullschleger. 1995. Fish distribution in limnetic areas of Lake Okeechobee, Florida. Archiv fur hydrobiologie, Advances in Limnology 45: 333-342.

Burns & McDonnell. 2003. Everglades Protection Area Tributary Basins, Long Term Plan for Achieving Water Quality Goals. South Florida Water Management District,.

Chiang, Wen-Hsing and Kinzelbach, Wolfgang. 2001. 3D-Groundwater Modeling with PMWIN, A Simulation System for Modeling Groundwater Flow and Pollution. Berlin, Germany, Springer Inc., 341 p.

Coale, F.J., C.A. Sanchez, F.T. Izuno, and A.B. Bottcher. 1993. Nutrientaccumulation and removal by sugarcane grown on Everglades Histosols. Agronomy Journal 85:310-315.

Conant, R. and Collins, J.T. 1991. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Boston, Massachusetts.

David, P. 1994. Wading Bird Nesting in Lake Okeechobee, Florida: An historic Perspective. Waterbirds. 17: 69-77.

Davis, S.M. 1991. Sawgrass and Cattail Nutrient Flux: Leaf Turnover, Decomposition, and Nutrient Flux of Sawgrass and Cattail in the Everglades. Aquatic Botany. 40:203-224.

Dennison, W.C., Orth, R.J., Moore, K.A., Stevenson, J.C., Carter, V., Kollar, S., Bergstrom, P.W., and Batiuk, R. 1993. Assessing Water Quality with Submerged Aquatic Vegetation. BioScience. 43: 86-94.

Dineen, J.W. 1974. Examination of Water Management Alternatives in Conservation Area 2A. Central and Southern Florida Control District in depth report 2(3), West Palm Beach, Florida.

Doren, R.F. and Jones, D.T. 1994. Non-Native Species Management in Everglades National Park. Pages 165-168 in An Assessment of Invasive Non-Indigenous Species in Florida's Public Lands. Florida Department of Environmental Protection, Tallahassee, Florida.

Duarte, C.M. 1991. Seagrass Depth Limits. Aquatic Botany. 40: 363-377.

Duever, M.J., Carlson, J.E., Meeder, J.F., Duever, L.C., Gunderson, L.H., Riopelle, L.A., Alexander, T.R., Myers, R.L., and Spangler, D.P. 1986. The Big Cypress National Preserve. Research Report No. 8. National Audubon Society. New York, New York.

Duever, M.J., J.F. Meeder, L.C. Meeder and J.M. McCollom. 1994. The climate of south Florida and its role in shaping the Everglades ecosystem. Pp. 225-248 in, Everglades. The ecosystem and its restoration (S.M. Davis and J.C. Ogden, eds.). St. Lucie Press, Delray Beach, FL.

Ewel, K.C. 1990. Swamps. Pages 281-323 in R.L. Myers and J.J. Ewel, (eds.) Ecosystems of Florida. University of Central Florida Press. Orlando, Florida.

Fernald, E.A., and Patton, D.J. 1984. Water Resources Atlas of Florida . Florida State University . 291 p.

Florida Agricultural Statistics Service. 2003. 2002 Census of Agriculture Summaries for State of Florida, Palm Beach County and Hendry County. Florida Agricultural Statistics Service, Orlando, Florida: http://www.nass.usda.gov/fl

Florida Department of Agriculture and Consumer Services. 1994. Florida Agriculture Facts.

Fox, D.D., Gornak, S., McCall, T.D. & Brown, D.W. 1992. Lake Okeechobee Fisheries Investigations, 1987-1992. Lake Okeechobee-Kissimmee River Project Report. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida.

Fox, D.D., Gornak, S., McCall, T.D. & Brown, D.W. 1993. Lake Okeechobee Fisheries Investigations, 1993. Lake Okeechobee-Kissimmee River Project Report. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida.

Frederick, P.C. and M.W. Collopy. 1988. Reproductive ecology of wading birds in relation to water conditions in the Florida Everglades. Florida Coop. Fish and Wildl. Res. Unit, Sch. For. Res. and Conserv. Univ. of Florida. Tech Rept. No. 30.

Frias-Torres, S. 2002. Oceanic transport and life history of the tropical western Atlantic opossum pipefish, Microphis brachyurus lineatus. Ph.D. Diss., Fla. Inst. Tech., Melbourne, Florida. 188 pp.

Furse, J.B., and Fox, D.D. 1994. Economic Fishery Valuation of Five Vegetation Communities in Lake Okeechobee, Florida. Annual Conference Southeast Associations of Fish and Wildlife Agencies. 48:575-591.

Gentry, R. C. 1974. Hurricanes in south Florida. Pp. 73-81 in Environments of south Florida: present and past (P. J. Gleason, ed.). Mem. Miami Geol. Soc. 2, Miami, Florida.

Gilmore, R.G. 1977. Fishes of the Indian River Lagoon and Adjacent Waters, Florida. Bulletin of the Florida State Museum. Vol. 22.

Gilmore, R.G. and P.A. Hastings. 1983. Observations on the ecology and distribution of certain tropical peripheral fishes in Florida. Florida Scientist 46 (1):31-51.

Gilmore, R.G. and C.R. Gilbert. 1992. Opossum pipefish, Microphis brachyurus lineatus, Family Syngnathidae, Order Syngnathiformes, pp 73-78 in C.R. Gilbert (ed.) Rare and Endangered Biota of Florida: Volume II. Fishes. Univ. Presses of Fla., Gainesville.

Glaz, B. 1995. Sugarcane Variety Census. Agronomy Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences,

Goldsborough, W.J. and Kemp, W.M. 1988. Light Responses of Submerged Macrophytes: Implications for Survival in Turbid Waters. Ecology. 69: 1775-1786.

Gunderson, L.H., and W.F. Loftus. 1993, The Everglades.p. 199–255. In W.H. Martin, G.G. Boyce, A.C. Echternacht (eds.). Biodiversity of the Southeastern United States: Terrestrial Communities. John Wiley & Sons, New York, NY, USA.

Haddad, K. and F. Sargent. 1994. Scars under the water. The Florida Naturalist Winter: 9-11.

Henry, A.C., D.A. Hosack, C.W. Johnson, D. Rol, and G. Bentrup. 1999. Conservation Corridors in the United States: Benefits and Planning Guidelines. Journal of Soil and Water Conservation. 54,4:645-650.

Hofstetter, Ronald H.; Parsons, Frances. 1979. The ecology of sawgrass in the Everglades of Southern Florida. In: Linn, Robert M., ed. Proceedings, 1st conference on scientific research in the National Parks; 1976 November 9-12; New Orleans, LA. Vol. 1. Transactions and Proceedings Series No. 5.

Washington, DC: U.S. Department of the Interior, National Park Service: 165-170.

IRL CCMP, 1996. Indian River Lagoon National Estuary Program. Indian River Lagoon Comprehensive Conservation and Management Plan. Sponsored by the St. Johns River Water Management District and South Florida Water Management District in cooperation with the U.S. Environmental Protection Agency. IRLNEP, Melbourne, FL, 1996.

Kenworthy, J. and Haunert, D. 1990. The Light Requirements of Seagrasses: Results and Recommendations of a Workshop Convened to Examine the Capability of Water Quality Criteria, Standards and Monitoring Programs to Protect Seagrasses from Deteriorating Water Transparency. SFWMD, West Palm Beach, Florida.

Kenworthy, W.J. 1997. An Updated Biological Status Review and Summary of the Proceedings of a Workshop to Review the Biological Status of the Seagrass, Halophila johnstoni Eiseman. Report submitted to the NMFS Office of Protected Resources, October 15, 1997. 24 pp.

Kenworthy, W.J. 1999. Demography, Population Dynamics, and Genetic Variability of Natural and Transplanted Populations of Halophila johnstoni, a Threatened Seagrass. Annual Progress Report, July, 1999.

Klein, Howard, M. C. Schroeder, and W. F. Lichtler. 1964. Report of Investigations No. 37, Geology and Ground-Water Resources of Glade and Hendry Counties, Florida. U.S. Geological Survey. Tallahassee, Florida.

Laroche, F.B., and Ferriter, A.P. 1992. Estimating Expansion Rates of Melaleuca in South Florida. Journal of Aquatic Plant Management 30:62:65.

Lichtler, William F. 1960. Report of Investigations No. 23, Geology and Ground-Water Resources of Martin County, Florida. Water Resources Division, U.S. Geological Survey. Tallahassee, Florida.

Lodge, T. 1994. The Everglades Handbook, Coral Gables, Florida.

Loveless, C. M. 1959. A study of the vegetation in the Florida Everglades. Ecology 40:1-9.

Mathews, Janet Snyder, Ph.D., Director, and State Historic Preservation Officer. December 13, 2002. Letter to James Duck, Chief, Planning Division, Environmental Branch, Jacksonville Corps of Engineers.

Mathews, Janet Snyder, Ph.D., Director, and State Historic Preservation Officer. May 13, 2004. Letter to James Duck, Chief, Planning Division, Environmental Branch, Jacksonville Corps of Engineers.

McDonald, M. G., and Harbaugh, A. W., 1988. A modular three-dimensional finite-difference ground water flow model: Techniques of Water-Resources Investigation Report, v. 06-A1.

McDowell, L.L., J.C. Stephens, and E.M. Stewart. 1969. Radiocarbon chronology of the Florida Everglades peat. Soil Sci. Soc. Am. Proc. 33:743-745.

Milleson, J.T. 1987. Vegetation Changes in the Lake Okeechobee Littoral Zone 1972-1982. Technical Publication No. 87-3. South Florida Water Management District. West Palm Beach, Florida

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1995. Status Reviews for Sea Turtles Listed under the Endangered Species Act of 1973 (Plotkin, P.T., Edit). National Marine Fisheries Service, Silver Spring, Maryland.

National Marine Fisheries Service. 2000. Status Review of Smalltooth Sawfish (Pristis pectinata).

National Marine Fisheries Service. 2004. Opossum Pipefish. http://www.nmfs.noaa.gov/pr/species/concern/profiles/opossum_pipefish.pdf. (Accessed August 19, 2005).

New South Associates, August 2003. Phase I Cultural Resource Survey, Everglades Agricultural Area, Storage Reservoirs Project, Component B, Palm Beach, County. U.S. Army Corps of Engineers, Jacksonville District.

Nikolits, Gary R. Palm Beach County Property Appraiser. Undated. Agriculture Appraisal Analysis.
http://www.co.palm-beach.fl.us/papa/Agriculture.html

Palm Beach County Board of County Commissioners. 2003. 1989 Comprehensive Plan Ordinances 2002 – 52, 79-84. West Palm Beach, Florida.

Palm Beach County Board of County Commissioners. 2004. Palm Beach County Evaluation and Appraisal Report – Second Draft. West Palm Beach, Florida.

Palm Beach County Health Department, Air Pollution Section, The Ambient Monitoring Group. 2005. The Clean Air Page, Air Quality Index supported by link to FDEP Air Resource Management, Clean Air Page.

Palm Beach County Planning Zoning and Building Department. 2001. Palm Beach County Comprehensive Plan Map Series Map LU 1.1 Managed Growth Tier System. West Palm Beach, Florida

Palm Beach County Planning Zoning and Building Department. 2004. Palm Beach County Developable* Lands. Board of County Commissioners. 2004. Palm Beach County Evaluation and Appraisal Report – Second Draft. West Palm Beach, Florida.

Palm Beach County Planning Zoning and Building Department - GIS. April 29, 2004. Palm Beach County Generalized Future Land Use Map. West Palm Beach, Florida.

Paul McGinnes, Carlos Adorisio, Julia Lacy, Damon Meiers, Vincent Peluso, Richard Pfeuffer, Barbara Powell, Steve Sentes, Stuart Van Horn and Shi Kui Xue, (2004), 2004 Everglades Consolidated Report, Chapter 8B: Everglades Stormwater Program; South Florida Water Management District

Pearlstine, L., F. Mazzotti, and D. DeAngelis. 2004. A review: Spatially explicit decision support sytems for landscape habitat assessment and restoration.
Piccone, T. 2004. Long Term Plan Update at Long Term Plan Communications Meeting, SFWMD, West Palm Beach Florida.

Puri, H.S., and Vernon, R.O., 1964, Summary of the geology of Florida and a guidebook to the classic exposures: Tallahassee, Fla., Florida Geological Survey, Special Publication No. 5.

Richardson, J.R. & Harris, T.T. 1995. Vegetation Mapping and Change Detection in the Lake Okeechobee Marsh Ecosystem. Arch. Hydrobiol. Beih. Ergebn. Limnol. 45: 17-39.

Robertson Jr., W. B., and J. A. Kushlan. 1984, The southern Florida avifauna: Pages 414-452 in P. J. Gleason (Ed.). Environments of south Florida: present and past II. Miami Geological Society Memoir 2.

Roka, Fritz and Cook, Dorothy. 1998. Farmworkers in Southwest Florida, Final Report. University of Florida Southwest Florida Research and Education Center. Immokalee, Florida.
http://www.spikowski.com/FarmworkeresinSWFlorida.html

Schardt, J.D., and Schmitz, D.C. 1992. Florida Aquatic Plant Survey. Technical Report 942-CGA. Florida Department of Environmental Protection. Tallahassee, Florida.

Schmitz, D.C., and Hoffstetter, R.H. 1994. Environmental, Economic and Human Impact. Pages 18-21 in F.B. Laroche, (ed.) Melaleuca Management Plan for Florida, Second Edition. Exotic Pest Plant Council.

Schomer, N.S. and Drew, R.D. 1982. An Ecological Characterization of the Lower Everglades, Florida Bay, and the Florida Keys. FWS/ OBS-82/58.1. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, D.C.

Shih, S.F., B. Glaz, and R.E. Barnes. 1997. Subsidence lines revisited in the Everglades Agricultural Area, 1997. University of Florida Bulletin (Tech.) 902.

Smith, J.P. and Collopy, M.W. 1995. Colony Turnover, Nest Success and Productivity, and Causes of Nest Failure among Wading Birds (Ciconiiformes) at Lake Okeechobee, Florida (1989-1992). Arch. Hydrobiol. Beih. Ergebn. Limnol. 45: 287-316.

Snyder, George H. January 2004, Everglades Agricultural Areas Area Soil Subsidence and Land Use Projects. U.S. Army Corps of Engineers, Jacksonville District.

South Florida Water Management District. May 2000. Lower East Coast Water Supply Plan.

South Florida Water Management District. December 2002. Everglades Agricultural Area Basin and Sub-Basin Delineation Report.

South Florida Water Management District. 2003a. Appendix H: Existing conditions, H.5 Environmental, Everglades Agricultural Area Storage Reservoirs, Phase 1.

South Florida Water Management District. 2003b. Comprehensive Everglades Restoration Plan, Central and Southern Florida Project, E.1 Regional Economic Impact, E.1.1 Socioeconomic Existing Conditions, Everglades Agricultural Area, Storage Reservoirs, Phase 1.

South Florida Water Management District. June 2004. Comprehensive Everglades Restoration Plan, Central and Southern Florida Project, H. Existing Conditions, H.6. Water Management, Everglades Agricultural Area Storage Reservoirs, Phase 1.

South Florida Water Management District. 2005 South Florida Environmental Report

Sprinkle, C.L. 1989, Geochemistry of the Florida Aquifer system in Florida and in parts of Georgia, South Carolina, and Alabama: U.S. Geological Survey Professional Paper 1403-I, 105 p., 9pls.

Stevenson, J., Staver, L.W., and Staver, K.W. 1993. Water Quality Associated with Survival of Submerged Aquatic Vegetation along an Estuarine Gradient. Estuaries. 16: 346-361.

Stocker, R. K., and D. R. Sanders, Sr. 1980. Melaleuca control studies in southern Florida. Proc. of the 33rd Annual Meeting of the Southern Weed Science Society.

Thomas, T. M. 1974. A detailed analysis of climatological and hydrological records of South Florida with reference to man's influence upon ecosystem evolution. In Environments of South Florida: Present and past, memoir no. 2., ed. P. J. Gleason, 82-122. Coral Gables, FL: Miami Geological Society.

Toth, L.A. 1988. Cattail Nutrient Dynamics. Technical Publication 88-06. South Florida Water Management District, West Palm Beach, Florida.

URS (SFWMD). March 18, 2003. Everglades Agricultural Area Storage Reservoirs—Phase I, Environmental Assessment Summary Document

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). 1999a. Central and Southern Florida Project Comprehensive Review Study: Final Integrated Feasibility Report and Programmatic Environmental Impact Statement, Appendix J, Existing Conditions. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). 1999b. Central and Southern Florida Project Comprehensive Review Study: Final Integrated Feasibility Report and Programmatic Environmental Impact Statement, Annex A, Attachment B. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers. June 1999. Draft Integrated Feasibility Report and Environmental Impact Statement for Lake Okeechobee Regulation Schedule Study. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). May 2003. Comprehensive Everglades Restoration Project Central and Southern Florida Project; Evaluation Criteria Fact Sheets, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). June 2003. Comprehensive Everglades Restoration Project Central and Southern Florida Project; Screening of Conceptual Alternatives, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). August 2003. Comprehensive Everglades Restoration Project Central and Southern Florida Project; B.3 Independent Benefits of Canal Improvements, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). September 2003. Comprehensive Everglades Restoration Project Central and Southern Project E.1. Regional Economic Impact (Economics Data Collection Work Plan) Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). October 2003. Comprehensive Everglades Restoration Project Central and Southern Project E.1.1 Socio Economic Existing Conditions Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). January 2004. Draft Final Existing Conditions Water Management Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). April 2004. Central and Southern Florida Project; Comprehensive Everglades Restoration Plan, Conceptual Alternative, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). May 25, 2004. Central and Southern Florida Project; Comprehensive Everglades Restoration Plan, PDT Meeting. Independent Technical Review Responses Power Point Presentation, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers. June 2004. Comprehensive Everglades Restoration Plan, Central and Southern Florida Project, A. Alternative Plan Formulation and Evaluation, A.1. Final Water Quality Assessment Report, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). July 2004. Central and Southern Florida Project; Comprehensive Everglades Restoration Plan, Alternative Plans Description, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). July 2004. Central and Southern Florida Project; Comprehensive Everglades Restoration Plan, Feasibility Scoping Meeting Documentation, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers and South Florida Water Management District (USACE and SFWMD). July 2004. Central and Southern Florida Project; Comprehensive Everglades Restoration Plan, Working Draft July 6, 2004, Strategy for Using Compartments B & C for Water Quality Improvements, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

U.S. Army Corps of Engineers. September 2004. Comprehensive Everglades Restoration Plan, Central and Southern Florida Project, A. Alternative Plan Formulation and Evaluation, A.1. Water Quality Assessment Report, Everglades Agricultural Area Storage Reservoirs, Phase 1. U.S. Army Corps of Engineers, Jacksonville District.

United State Bureau of the Census. 2001. 2000 Census Report. Washington, D.C.

USDA National Agricultural Statistics Service. Agriculture Statistics Data Base, Track Records United States Crop Production: Sugarcane: Acreage, Yield, Production, Price, and Value of Production, 1909 to 1904. USDA Website http://www.usda.gov.nass/.

USDA National Agricultural Statistics Service. Agriculture Statistics Data Base, County Level Data for Florida Crops, Sugarcane for Sugar Production, Palm County and Hendry County 1975 to 2003. USDA Website http://www.usda.gov.nass.

U.S. Fish and Wildlife Service. 1999. Multi-Species Recovery Plan for the Threatened and Endangered Species of South Florida, Volume I.

U.S. Fish and Wildlife Service. 2002. http://ecos.fws.gov/species_profile/servlet/gov.doi.species_profile.servlets.Species_HCP

U.S. Fish and Wildlife Service. November 2003. Everglades Agricultural Area Storage Reservoirs Project, Phase I - Environmental Existing Conditions. South Florida Ecological Services Field Office, Vero Beach, Florida.

U.S. Fish and Wildlife Service and Florida Fish and Wildlife Conservation Commission (Service and FWC). 2004. Planning Aid Report, Multi-species conservation under the comprehensive Everglades restoration plan (CERP)- Part 1, Initial CERP Update (ICU) footprint analysis, Appendix E, February 27, 2004. South Florida Ecological Services Field Office, Vero Beach, Florida.

U.S. Fish and Wildlife Service. August 2005. Everglades Agricultural Area Storage Reservoir Draft Fish and Wildlife Coordination Act Report. South Florida Ecological Services Field Office, Vero Beach, Florida.

University of Florida Bureau of Economic and Business Research. 1995. Florida Statistical Abstract. University Press of Florida. Gainesville, Florida.

University of Florida Bureau of Economic and Business Research. 2001. Florida Statistical Abstract. University Press of Florida. Gainesville, Florida.

University of Florida Bureau of Economic and Business Research. 2002. Florida Statistical Abstract 2002. University Press of Florida. Gainesville, Florida.

Virnstein, R. and Campbell, D. November 1987. Indian River Lagoon Joint Reconnaissance Report. Chapter 6. Biological Resources.

Virnstein, R.W., L.J. Morris, J.D. Miller, and Robbyn Miller-Myers. 1997. Distribution and abundance of Halophila johnsonii in the Indian River Lagoon. St. Johns River Water Management District Tech Memo #24. November 1997. 14 pp.

Water and Air Research, Inc. Sep 2005. Draft Final EAA Storage Reservoirs EIS, Water Quality Assessment Report (WQAR) Draft Final. Written for and Reviewed by Jacksonville District U.S. Army Corps of Engineers.

Wenger, S. 1999. A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation. University of Georgia. Athens Georgia.

Wetland Solutions, Inc. June 2004. Draft Final EAA Storage Reservoirs EIS, H) Existing Condition, H7) Water Quality. Written for and Reviewed by Jacksonville District U.S. Army Corps of Engineers.

Woodward- Clyde Consultants. 1994. Indian River Lagoon National Estuary Program, Melbourne, FL. Woodward- Clyde Consultants. Florida.

SECTION 14
INDEX

This page intentionally left blank.

14.0 INDEX

Adaptive Assessment 5-47, 5-50, 6-18
Additional Storage 5-3
Aesthetic 2-41, 2-53, 2-54
Aesthetics 2-53, 2-54, 5-55, 7-23, 9-8
Agricultural Area 2-31, 2-38, 5-18, 5-24, 5-36, 7-7, 7-15, 7-23
Air Quality 2-8, 5-55, 5-59, 7-4, 9-6
Alternative
Final Array 1-21, 2-4, 3-3
Alternative 5-12, 5-13, 5-14, 5-16, 5-21, 5-22, 5-25, 5-27, 5-30, 5-32, 5-33, 5-40, 5-45, 5-54, 5-55, 5-56, 5-59, 5-61, 5-62, 5-65, 5-66, 6-1, 6-15
Alternative Plans 5-1, 5-2, 5-11, 5-26, 5-34, 5-47, 5-49, 5-60, 5-61
Alternatives 4-8, 5-1, 5-11, 5-12, 5-21, 5-22, 5-25, 5-26, 5-32, 5-33, 5-34, 5-35, 5-40, 5-41, 5-43, 5-45, 5-47, 5-49, 5-51, 5-60, 5-61, 5-62, 5-65, 5-66
American Alligator 2-18, 2-20, 2-21, 2-25, 2-26, 2-27, 2-31, 7-13
Annual Costs 5-65, 6-18
Annualized Benefits 5-40
Aquatic 1-14, 2-9, 2-10, 2-13, 2-15, 2-20, 2-41, 5-23, 5-24
Aquifer 5-7, 7-2
ASR 5-7, 5-8, 5-11, 7-33
Audubon's Crested Caracara 2-29

B

Bald Eagle 2-25, 2-26, 2-29, 7-11
Beneficial Effects 8-7
Benefit 1-8, 3-6, 3-7, 3-8, 3-9, 4-1, 5-23, 5-30, 5-33, 5-40, 5-41, 5-43, 6-14, 6-35, 6-36, 7-2, 7-3, 7-11, 7-12, 7-13, 7-16, 7-19, 7-31, 7-32, 7-33, 8-1, 8-7, 9-8, 9-9, 9-10, 9-13, 9-14
Benefits 7-1, 7-8, 7-14, 7-17, 7-20
Beneficial Effects 8-7
Bridge 6-6, 6-7, 6-25

C

CERP 1-2, 1-11, 1-14, 1-20, 2-1, 2-28, 2-40, 6-3, 6-34, 8-6, 10-1, 10-5
Clean Air Act 7-4
Clean Air Act of 1972 9-6
Clean Water Act of 1972 9-6
Climate 2-6, 2-7, 2-31, 3-3, 7-3
Commitments of Resources 5-31
Compartment 1-17
A 1-17, 2-3, 2-5, 2-11, 2-13, 2-14, 2-20, 2-27, 2-28, 2-30, 2-36, 2-37, 2-42, 2-47, 2-50, 2-51, 2-52, 2-54, 2-55, 2-56, 2-58, 3-1, 3-4, 3-5, 3-6, 3-7, 3-8, 3-9, 3-13, 3-14, 5-4, 5-11, 5-21, 5-22, 5-31, 5-32, 5-33, 6-3, 6-32, 7-9, 7-12, 7-13, 7-15, 7-16, 7-19, 7-21, 7-22, 7-23, 7-24, 9-10
B 5-11
C 1-14, 5-11
Compliance 9-6, 9-7, 9-8, 9-9, 9-10, 9-12, 9-13, 9-14
Comprehensive Everglades Restoration Plan ..... See CERP
Construction 5-2, 5-11, 5-12, 5-17, 5-18, 5-22, 5-25, 5-26, 5-27, 5-28, 5-29, 5-45, 5-48, 5-51, 5-66, 7-3, 1-10, 2-30, 2-54, 2-55, 3-7, 3-9, 6-2, 6-17, 6-18, 6-20, 6-22, 7-1, 7-4, 8-2, 9-8, 9-11, 9-12
Contamination 2-55, 2-56
Conveyance Improvements 5-21
Cost 6-15, 6-16, 6-17, 6-18, 6-19, 6-24, 6-26, 6-31, 6-32

Cost Apportionment 8-4
Cost Effectiveness 5-69, 9-1, 9-7
Cost Estimates 5-8, 5-18, 5-25, 5-26, 5-27, 5-28, 5-29, 5-48
Cost Share 8-1, 8-3
Cost Sharing 1-17, 8-1, 8-3
Cost-Effective 5-1, 5-2, 5-10, 5-11, 5-12, 5-60, 5-61, 5-63, 5-65
Cultural Resources 5-29, 5-31, 5-55, 6-37, 7-24, 8-2, 8-13, 9-10, 9-11
Culvert 5-25, 6-6, 6-7, 6-8, 6-22, 6-30
Cut-off Wall 5-49

D

Design Criteria 6-21
Detailed Design Phase 4-4, 8-4
Disturbed Communities 2-14

E

Eastern Indigo Snake 2-30
Ecological Benefits 5-34
Ecological Response Time 5-49
Economic 5-26, 5-32, 5-33, 7-32
Economics 3-4, 5-19
Economy 2-51, 5-65, 6-36, 7-32
Effects on Legal Sources of Water 8-6
Electrical Design 6-24, 6-25, 6-30
Embankment Construction 5-11, 5-16, 5-18, 5-48
Embankments 6-19, 6-20
Employment 2-46, 5-32, 5-56, 5-59, 6-36, 7-19, 7-20, 7-21, 7-22
Endangered 2-18, 2-21, 2-22, 2-26, 2-27, 2-28, 2-30, 2-31, 2-32, 2-33, 2-34
Endangered Species Act of 1973 9-9
Engineering 5-28, 5-48, 5-49
Enhance Economic Values and Social Well Being 1-7, 4-8
Environment 1-2, 1-4, *1-5*, 3-1, 3-14
Environmental Commitments 8-11
Environmental Effects 7-1
Environmental Justice 7-21, 9-13
Essential Fish Habitat (EFH) 2-37, 9-9
Evaluation 4-8, 5-1, 5-2, 5-4, 5-6, 5-9, 5-11, 5-26, 5-33, 5-34, 5-35, 5-39, 5-49, 5-50, 5-66
Evapotranspiration 2-7
Everglade Snail Kite 2-30
Everglades Construction Project 2-55, 3-1, 3-7, 6-2, 7-10, 7-17
Exotic Plants 2-9

F

Fish 2-6, 2-10, 2-16, 2-17, 2-18, 2-19, 2-20, 2-23, 2-26, 2-29, 2-31, 2-33, 2-34, 2-40, 2-43, 2-51, 2-55, 8-6, 8-8
Fish and Wildlife Coordination Act of 1958 9-8
Flood 2-7, 2-38
Flood Protection *1-5*, 1-8, 1-10, 1-11, 1-20, 2-2, 2-38, 3-2, 4-6, 4-8, 5-1, 5-3, 5-5, 5-6, 5-10, 5-21, 6-34, 7-1, 7-3, 8-5, 8-13
Florida Department of Transportation 2-58
Florida Panther ... 2-21, 2-25, 2-27, 3-8, 7-9
Florida Statutes
373.026 1-20
373.1501 1-20
Flow-way 5-9

G

Geology 2-4, 3-2, 5-53, 5-58, 6-19, 7-1
Gopher Tortoise 2-25
Groundwater 2-6, 2-57, 5-7

H

Habitat Units 5-4, 5-45, 5-47, 5-54, 5-60, 5-61, 5-63, 5-65, 5-66, 5-67, 6-34

History....2-1
Hydrologic Modeling....5-47
Hydrology....2-6

I

Implementation....5-22
Implementation Schedule....8-2
Implementing....8-1, 8-3, 8-9
Income....2-46, 6-32, 7-21, 9-13
Incremental....5-26, 5-49, 5-60, 5-63, 5-64, 5-65
Incremental Cost Analyses....5-26, 5-60

J

Johnson's Seagrass....2-34

L

Lake Okeechobee....1-7, 1-8, 1-9, 1-10, 1-13, 1-15, 1-19, 1-21, 2-2, 2-4, 2-5, 2-6, 2-7, 2-8, 2-9, 2-10, 2-11, 2-16, 2-18, 2-26, 2-28, 2-29, 2-30, 2-34, 2-36, 2-38, 2-39, 2-40, 2-42, 2-46, 2-48, 2-50, 2-53, 2-57, 2-59, 3-2, 3-3, 3-4, 3-5, 3-6, 3-8, 3-9, 3-10, 3-11, 3-13, 4-1, 4-2, 4-3, 4-4, 4-5, 4-6, 4-7, 5-1, 5-2, 5-3, 5-4, 5-5, 5-6, 5-7, 5-8, 5-9, 5-10, 5-11, 5-19, 5-20, 5-21, 5-32, 5-33, 5-34, 5-35, 5-36, 5-37, 5-38, 5-40, 5-41, 5-42, 5-45, 5-47, 5-50, 5-61, 5-66, 5-67, 5-68, 6-1, 6-2, 6-3, 6-5, 6-8, 6-9, 6-10, 6-11, 6-23, 6-34, 6-35, 6-36, 6-37, 7-2, 7-5, 7-8, 7-10, 7-11, 7-12, 7-13, 7-14, 7-15, 7-16, 7-17, 7-18, 7-20, 7-21, 7-22, 7-23, 7-24, 7-25, 7-31, 7-32, 7-33, 8-5, 8-6, 8-7, 8-12, 9-1, 9-7, 9-8, 9-10, 9-11, 10-1
Land Acquisition....1-17, 5-22, 5-26, 5-27, 5-45, 5-57, 5-65, 5-66
Land Use....2-1, 2-36, 2-48, 2-50, 2-55, 2-58, 3-1, 3-2, 3-4, 3-5, 3-9, 3-11, 3-13, 3-14, 5-3, 7-20, 7-22, 7-32, 9-11
Levees....6-9, 6-10
Listed Species....2-17, 2-22, 2-24, 2-27, 2-36
Listed Species....9-8
American Alligator....2-31, 7-13
Bald Eagle....2-29, 7-11, 8-11, 8-12
Florida Burrowing Owl....2-25, 2-37, 3-8, 3-9, 7-15, 8-12
Florida Panther....2-27, 7-9, 7-30
West Indian Manatee....2-27, 7-9
Wood Stork....2-28, 7-10
Littoral Shelves....5-24
Littoral Zone....6-13

M

Management Measures....5-2, 5-11, 5-23, 5-48
Manatee Protection....9-10
Marine Mammal Protection Act of 1972....9-9
Mechanical Design....6-23
Mitigation....7-1, 8-5, 10-4
Modeling....*1-4*, 1-17, 2-2, 2-53, 4-8, 5-11, 5-32, 5-66, 5-67, 5-68, 6-34, 6-36, 7-2, 7-14, 8-5
Monitoring Programs....2-40

N

NAI....6-34, 6-35
National Ambient Air Quality Standards....9-6
National Ecosystem Restoration (NER) Plan....5-64
National Environmental Policy Act....1-3, 1-7, 3-1, 6-1, 7-24
National Historic Preservation Act of 1966....2-55, 7-24, 9-10
Natural System....*1-5*, 1-7, 1-11, 1-20, 1-21, 2-30, 4-2, 4-3, 4-4, 4-7, 5-3, 5-5, 5-6, 5-7, 5-8, 5-37, 5-50, 6-3, 6-35, 7-1, 7-31, 7-32, 8-7
NEPA....9-1, 9-7
Noise....2-8, 2-54, 3-3, 5-30, 7-4, 7-8, 7-17

O

Okeechobee Gourd..... 2-34
OMRR&R.....6-17, 6-33
Opossum Pipefish 2-33
Opportunities.....5-1, 5-2, 5-23, 5-24, 6-1
Overview..... 2-46, 2-54, 2-55

P

Performance Measures.....
2-2, 4-8, 5-1, 5-4, 5-33, 5-34, 5-35, 5-36, 5-38, 5-39, 5-40, 5-41, 5-49, 5-50, 5-67, 6-34
Planning Aid Letters 9-8
Poverty 2-46
Problems and Opportunities.....
..... 4-1, 9-1, 9-7
Project Cooperation Agreement.....
..... 1-20, 10-4, 10-5
Project Implementation.....
..... 1-6, 5-50, 5-67, 6-33, 8-6, 8-8
Project Management Plan 9-6
Project Operations.....8-3, 8-4
Pump Station.....
.....6-5, 6-6, 6-7, 6-8, 6-9, 6-23, 6-31
Pump Stations 5-12, 5-19, 5-20, 7-3
Purpose.....1-2, *1-4*, 1-10, 1-11

R

Rainfall.....
1-9, 2-6, 2-7, 3-3, 4-1, 4-4, 5-7, 6-12, 6-35, 7-3, 7-5, 7-16, 7-32
RCC.....
5-12, 5-16, 5-18, 5-25, 5-27, 5-28, 5-48
Real Estate .....
1-17, 5-26, 5-29, 5-57, 5-59, 5-66, 6-15, 6-17, 6-33
RECOVER.....6-34, 6-35, 6-36, 8-9
Recreation .....
1-10, 1-20, 2-40, 2-50, 3-12, 5-25, 5-54, 6-14, 7-23, 7-30, 8-6
Recreational Opportunities 2-50
Refugia.....5-23, 5-24, , 6-13, 9-8, 9-13
Restoration 6-3, 6-27, 6-32
Restudy .....
2-1, 2-56, 5-1, 5-2, 5-4, 5-6, 5-9, 5-10, 5-11, 5-50, 7-32
Ridge and slough.....
.....5-43, 5-45, 5-61, 6-2, 7-19
Riprap..... 5-17, 5-19, 6-20
Risk and Uncertainty.....
.....5-48, 5-57, 5-59, 5-65, 5-66
Roseate Spoonbill 2-25

S

Savings Clause.....5-21
Scoping 4-2, 9-1, 9-7, 9-10
Screening.....5-1, 5-11, 5-12, 6-34
Sea level.....2-4, 3-3
Sea Turtles 2-31
Section 390.....1-17
Sediments.....2-6, 2-10, 2-35, 2-57
Seepage .....
6-1, 6-5, 6-7, 6-8, 6-9, 6-20, 6-21, 6-27, 6-32
Seepage Buffer.....
.....5-23, 5-46, 6-20, 6-21, 6-32
Seepage Canals 5-19, 5-20, 5-23, 5-24
Sequencing and Adaptive Assessment.....
.....5-50
SFWMD Adaptive Management Strategy
.....6-3
SFWMD Everglades Regulatory Program
.....6-3
SFWMD Long-term Plan.....6-3
Sheet Flow .....
..... 1-13, 1-19, 2-38, 4-4, 5-9, 9-14
Smalltooth Sawfish 2-33
Socioeconomic Characteristics ..2-44, 2-47
Socioeconomics 5-32
Soils.....
1-15, 2-1, 2-4, 2-5, 2-6, 2-13, 2-14, 2-38, 2-39, 2-48, 2-56, 3-1, 3-4, 3-5, 3-11, 3-13, 5-47, 5-59, 6-36, 7-2, 7-15, 7-19, 7-25, 7-31
South Florida Water Management Model
.....2-2
Species 9-9, 9-14

Spillways 5-12, 5-20, 5-25, 5-28
STA .....
1-8, 1-13, 1-14, 1-17, 1-21, 2-2, 2-39, 2-40, 2-42, 2-43, 2-48, 2-51, 2-52, 2-53, 2-55, 2-58, 3-1, 3-3, 3-5, 3-10, 3-11, 4-4, 4-7, 5-10, 5-12, 5-18, 5-20, 5-36, 5-37, 5-38, 5-59, 5-69, 6-2, 6-4, 6-6, 6-7, 6-8, 6-9, 6-11, 6-15, 6-27, 6-33, 6-34, 6-35, 7-1, 7-2, 7-3, 7-4, 7-5, 7-6, 7-7, 7-9, 7-11, 7-18, 7-30, 8-5
Storage Reservoirs 9-1, 9-7
Stormwater Treatment Areas ..... See STA
Study Area .....
1-15, 1-19, 2-1, 2-22, 2-35, 2-38, 2-42, 2-49, 2-58, 3-1, 4-1, 4-2, 4-6, 5-1, 5-19, 5-32, 5-49, 5-56, 6-1, 7-16, 7-17, 9-1, 9-7
Surface Waters 2-4
System .....
1-5, 1-7, 1-11, 1-20, 2-1, 2-2, 2-5, 2-6, 2-7, 2-18, 2-19, 2-23, 2-30, 2-38, 2-39, 2-42, 2-54, 3-2, 3-7, 3-8, 4-2, 4-3, 4-4, 4-7, 5-1, 5-2, 5-3, 5-7, 5-8, 5-10, 5-23, 5-33, 5-34, 5-35, 5-37, 5-38, 5-39, 5-49, 5-50, 5-57, 5-68, 6-3, 6-8, 6-21, 6-22, 6-25, 6-26, 6-27, 6-28, 6-29, 6-31, 6-34, 6-35, 6-36, 7-1, 7-2, 7-3, 7-7, 7-9, 7-12, 7-16, 7-18, 7-24, 7-31, 7-32, 8-7, 8-8, 8-9, 10-1

T

Talisman 5-1, 5-22, 5-65
Topography 2-4
Toxic 9-11
Tree Island .....
1-19, 2-14, 2-15, 2-16, 2-22, 2-23, 2-54, 3-6, 3-7, 4-4, 5-23, 5-24, 5-36, 5-43, 5-45, 5-46, 5-61, 6-12, 6-13, 6-20, 7-5, 7-19
Tree Islands 9-8, 9-14
Tricolored Heron 2-25

U

U.S. Fish and Wildlife Service 1-20, 2-24, 7-9, 9-9
Uniform Relocation Assistance Benefits 6-33
Unique Land Forms 2-6
Upland 5-23, 7-7, 7-8, 7-13, 7-23
Uplands 2-14, 2-21
Urban and Extractive Communities 2-14
Utility Relocation 6-23

V

Vegetation .....
2-8, 2-9, 2-10, 2-11, 2-13, 2-14, 2-15, 2-16, 2-17, 2-20, 2-21, 2-28, 2-34, 2-36, 2-37, 2-39, 2-42, 2-53, 2-54, 2-56, 3-3, 3-4, 3-5, 3-6, 3-7, 3-8, 4-5, 4-6, 5-9, 5-23, 5-24, 5-42, 5-47, 5-50, 5-51, 6-12, 6-37, 7-4, 7-5, 7-6, 7-7, 7-12, 7-13, 7-14, 7-18, 7-33, 9-8, 9-10, 9-14

W

Wading Birds 9-9
Water
Agricultural Use 8-6
Ground .....
2-6, 2-38, 4-7, 5-7, 6-12, 6-22, 7-2, 7-5, 8-5, 8-6
Management .....
2-1, 2-2, 2-5, 2-22, 2-36, 2-38, 2-40, 2-50, 3-5, 3-10, 4-2, 4-4, 5-37, 5-38, 7-16, 7-17, 7-31, 8-4, 8-7, 8-8
Quality .....
1-2, *1-4*, *1-5*, 1-7, 1-8, 1-20, 2-1, 2-2, 2-6, 2-10, 2-34, 2-35, 2-36, 2-38, 2-39, 2-40, 2-41, 2-42, 2-43, 2-44, 2-50, 2-52, 2-53, 3-2, 3-4, 3-6, 3-7, 3-8, 3-9, 3-10, 3-11, 3-13, 4-3, 4-4, 4-7, 4-8, 5-4, 5-5, 5-6, 5-7, 5-8, 5-12, 5-21, 5-24, 5-25, 5-31, 5-32, 5-36, 5-40, 6-1, 6-3, 6-11, 6-17, 6-35, 6-37, 7-7, 7-13, 7-14, 7-15, 7-17, 7-18, 7-22, 7-33, 8-5, 8-9, 9-5
Supply 8-6

Surface2-6, 2-40, 2-41, 2-42, 3-4, 3-6, 3-7, 3-9, 3-11, 4-2, 4-3, 5-7, 7-16, 7-31
Use
Agricultural 4-3
Water Conservation Areas 2-8, 2-14, 2-21, 2-27, 2-44
Water Management 1-19, 2-1, 2-2, 2-5, 2-22, 2-36, 2-38, 2-40, 2-50
Water Management 1-19
Water Quality Monitoring Plan 8-9
Water Supply *1-4*, *1-5*, 1-8, 1-13, 1-20
Wave Breaking Bench 5-19, 6-19
West Indian Manatee 2-18, 2-20, 2-25, 2-26, 2-27, 2-28, 3-8
Wetland 2-13, 2-20
Wetlands 2-5, 2-9, 2-13, 5-24, 5-32, 5-39, 7-5, 7-6, 7-7, 7-10, 7-11, 7-12, 7-13, 7-15, 7-19, 7-30, 7-31, 9-13
Wildlife 2-6, 2-8, 2-16, 2-17, 2-19, 2-20, 2-22, 2-23, 2-26, 2-40, 2-51, 2-53, 2-54, 5-3, 5-23, 5-24, 5-32, 5-46, 5-50, 5-51
Wildlife
Amphibians 2-16, 2-17, 2-18, 2-21, 2-22, 7-6, 7-7
Birds 2-16, 2-17, 2-18, 2-19, 2-20, 2-21, 2-22, 2-23, 2-26, 2-29, 2-31, 2-36, 2-51, 2-54, 3-6, 3-9, 4-6, 7-6, 7-7, 7-11, 7-15
Fish 1-10, 2-6, 2-10, 2-16, 2-17, 2-18, 2-19, 2-20, 2-23, 2-26, 2-29, 2-31, 2-33, 2-34, 2-37, 2-40, 2-43, 2-51, 2-55, 2-56, 3-6, 3-7, 4-5, 4-6, 5-24, 5-31, 5-37, 5-38, 5-42, 5-50, 5-55, 6-13, 6-21, 6-34, 6-37, 7-5, 7-6, 7-14, 7-18, 7-30, 7-33, 8-13
Invertebrates 2-26, 2-32, 3-6, 4-6, 7-6
Reptiles 2-16, 2-17, 2-18, 2-23, 4-6, 7-6, 7-7
Wading birds 2-17, 2-19, 2-20, 2-21, 2-22, 2-23, 2-26, 2-29, 2-36, 2-51, 3-6, 3-9, 4-6, 5-3, 5-24, 6-13, 6-37, 7-5, 7-6, 7-8, 7-11, 7-15, 7-33
Wood Stork 2-17, 2-22, 2-23, 2-26, 2-27, 2-28, 2-29, 3-8, 7-11, 8-11, 8-12
WRAP 5-46

US Army Corps
of Engineers®